BULLETIN No. 6—NEW SERIES.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

PROCEEDINGS

OF THE

EIGHTH ANNUAL MEETING

OF THE

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1896.

DIVISION OF ENTOMOLOGY.

Entomologist: L. O. Howard.
Assistant Entomologists: C. L. Marlatt, Th. Pergande, F. H. Chittenden.
Investigators: E. A. Schwarz, H. G. Hubbard, W. H. Ashmead, D. W. Coquillett.
Assistants: Frank Benton, R. S. Clifton, F. C. Pratt.
Artist: Miss L. Sullivan.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., September 16, 1896.

SIR: I have the honor to transmit herewith the manuscript of the secretary's report of the proceedings of the eighth annual meeting of the Association of Economic Entomologists, which was held at Buffalo, N. Y., August 21 and 22, 1896. From the fact that the proceedings of this association are of the highest economic importance the Department has hitherto published the secretary's reports in the bulletins of this division, and I therefore recommend that the present report be published as No. 6 of the new series of bulletins.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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* Withdrawn for publication elsewhere.

ILLUSTRATIONS.

EIGHTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

MORNING SESSION, AUGUST 21, 1896.

The association was convened in the lecture hall of the Library building, Buffalo, N. Y. The following officers and members were present:

President, C. H. Fernald; vice-president, F. M. Webster; secretary, C. L. Marlatt; M. F. Adams, C. J. S. Bethune, R. A. Cooley, James Fletcher, E. H. Forbush, C. W. Hargitt, A. D. Hopkins, L. O. Howard, J. A. Lintner, W. G. Johnson, D. S. Kellicott, A. H. Kirkland, G. H. Perkins, F. W. Rane, M. V. Slingerland, J. B. Smith.

The following entomologists, not members of the association, were also present:

W. S. Blatchly, C. D. Zimmerman, E. P. Van Duzee, Ottomar Reinecke, C. W. Needham.

There were also present at the meetings a number of zoologists and other visitors, the attendance averaging from 25 to 30 persons.

The association was called to order by the president, and the presentation of his annual address immediately followed.

THE EVOLUTION OF ECONOMIC ENTOMOLOGY.

By C. H. FERNALD, *Amherst, Mass.*

The earliest accounts of injuries caused by insects, so far as I have seen, are contained in the Old Testament, but nowhere in this work is it stated that attempts of any kind were made to destroy the insects or hold them in check in any way. In many instances the visitations of insects in large numbers were looked upon as plagues sent by the Almighty. Three of the plagues of Egypt, portrayed so vividly in the book of Exodus, were caused by insects—one by lice, one by flies, and one by locusts—but in each case Pharaoh looked for and sought relief only by Divine interposition through the good influences of Moses, "the great lawgiver."

In the book of Joel sundry judgments of God are declared, among which the devastations of insects are referred to with some detail. The prophet seems to take a pessimistic view of their work, but no hint is given or even suggested of any method of checking their ravages.

Aristotle, in his History of Animals, written about two hundred years before the Christian era, while treating of insects gives us nothing whatever of an economic nature concerning them. Pliny, in his great work on the History of the World, written about the year 77 of the Christian era, has given much of interest concerning the work of insects and the methods of destroying them adopted in those times. In the eleventh book of this work, page 327, it is stated that "if the spring be wet and rainy the eggs of locusts, which have remained in the ground during the winter, perish and do not hatch." Pliny further states that "whole armies of locusts often come from Africa into Italy," and many a time the people of Rome, fearing a famine, had recourse to the Sibylline books for a remedy and to avert the wrath of the gods. These books were supposed to contain the fate of the Roman Empire In the Cyrenian Province of Barbary, it was ordered by law that all the inhabitants should wage war against the locusts, first by hunting for their eggs and crushing them, second by killing the young, and lastly by destroying the adults. A severe punishment was inflicted on those who neglected to perform this duty. On the island of Stalimni it was determined just what quantity each man should kill, and the full measure was required to be exhibited to the magistrate. The people made much account of the assistance rendered by the jays and other birds in destroying the locusts. This account given by Pliny is the earliest concerning the enactment of laws for the destruction of insects that I have anywhere found.

This is more in accordance with our modern ideas on economic entomology than the remedy given by Cato for caterpillars on fruit trees, which was to moisten the tips of the twigs with the gall of a green lizard, or the remedy for cankerworms given by Pliny, which was to hang the bones of a mare's head on the pales around the garden. He emphasizes the fact that the bones must be those of a female, as those of the male would prove of no avail. It appears that the common people needed special cautioning in these matters in the days of Pliny, just as they do to-day.

In the twenty-fifth book, chapter five, Pliny says that if white hellebore be powdered and put into milk all the flies that eat of it will be destroyed. This is the earliest mention I have found of the use of white hellebore as an insecticide. I do not know who claims the honor of the discovery of hellebore as an insecticide in modern times.

The next account, in order of time, that I have been able to find is given by Berg in his History of the German Forests. In the year 875 hosts of grasshoppers appeared on the Rhine and destroyed all the grass and grain. The remedies employed for their destruction were by the priests, who went in procession around the infested fields, carrying holy relics and making intercessory prayers, "but," adds the chronicler, "it was of no avail." This was said to be the oldest record to be found of methods of treating insects in German lands and was taken from the Bavarian chronicle of Aventinus.

During the Middle Ages lamentations over the destructive ravages of different species of insects are of frequent occurrence in many chronicles of those times. The means used for the destruction of insects were all, so far as we can learn, of a spiritual nature. Uhland, in his contributions to the history of poetry and legend, relates that in the fourteenth century the bishops of Chur and Lausanne pronounced the anathema over grasshoppers and other insects. At one time a thoroughgoing procedure, according to all the rules of jurisprudence, occurred before the spiritual judge. The accused insects were summoned, and in case of nonappearance, which always occurred, unless the insects were moving to new feeding grounds and the court-house happened to be in their way, a proxy was appointed to represent the accused insects, who debated the whole subject with the accuser, after which judgment was rendered, invariably against the accused insects in the form of an excommunication, which was carried into effect only when the insects disappeared at the time of pupation.

Lesser, in his Insecto-Theology, published in London in 1799, says:

We are at this day still almost in the dark with regard to those means by which we may deliver ourselves from the depredations of insects. In the Church of Rome recourse has been had to different exorcisms. Other people have fabricated amulets and talismans to which great virtues have been attributed. * * *

Whatever credit these means may have gained with the people, they are far from having the efficacy of prayer or the worth of the remedies I am about to prescribe.

There are several ways of preventing the increase of insects. The easiest and most natural, in my opinion, are the following: By spreading on the ground ashes mixed with pigeons' or goats' dung, not only insects newly come forth, but those about to be hatched are destroyed. By destroying the old ones we rid ourselves of the generation they would have produced, and we thus perform in an instant what we would not fail to have been employed in during the whole course of a year. But should the season anticipate our intentions, we must seek their nests in the furrows and clefts of trees. In truth, the industry of insects in choosing places in which their brood may be in safety makes it impossible but some of them will escape our search; but if in one province the country people would use stratagems on their part it is certain that they would insure that profit of which they are often frustrated.

We can not defend fruit trees from the ravages of caterpillars better than by carefully pruning them. By this they acquire much more sap, and, as these insects are not fond of too abundant juice, they seek elsewhere a food more to their taste. If the approach of winter obliges them to gather together in the nests which they form at the extremities of the branches, they must be taken off before the spring has made any progress.

It is possible that these means may not be practicable at all times; but then other stratagems must be fallen upon to stifle the evil in its birth. If caterpillars, ants, and other insects roam over the ground, and have not yet gotten upon the trees they are in search of, a stratum of ashes or of chalk must be laid at the bottom, which will obstruct their passage. I believe this to be infallible; for, besides that they are enemies to all constraint, they would be so embarrassed by these substances that they would not be able to disengage themselves. Twisted straw, clay, wool, and cotton are likewise successful obstacles to their ascent. Circles of them are put around the stem of the tree, and if a little resinous substance is added to them the tree will be out of danger. Let us change the case. Suppose the insects have already gotten upon the trees, plants, and bushes, the hand must be employed. But there are some times when this is done with greater success than at others, as in the morning, the evening,

and during rain. These times are preferable to any other part of the day, because coolness and humidity cause insects to collect together, and then they form heaps which may be crushed at once. If, moreover, they have gained the top and the height prevents their being reached with the hand, the tree must be shaken, or a pole with rags on the end of it employed to sweep them off. But expedients must be suggested by circumstances. Another snare, the success of which is not less happy, for securing fruit trees is to lay the trunk over with glue, etc.

This represents fairly well the status of economic entomology at the end of the last century. It is undoubtedly true that the great advances made in the systematic study of insects during the last half of the eighteenth century by Linnæus, Fabricius, Denis, and Schiffermüller, Esper, Herbst, Schrank, Illiger, Scopoli, Latreille, Rösel, Panzer, Olivier, and a host of others, gave a great impetus to economic entomology, as shown by the remarkable work of Bechstein on Forest Insects, published in 1804–5; Hints to the Proprietors of Orchards, by Salisbury, published in London in 1816; Kollar's Insects Injurious to Farmers and Gardeners, published in 1836; Ratzeburg's Forest Insects, published in 1840, with many others in Europe, while in this country there were numerous essays on injurious insects and methods of destroying or holding them in check published in the early part of this century. Harris published numerous papers on economic entomology in the New England Farmer, beginning as early as 1823, but his classic work on the Insects of Massachusetts Injurious to Vegetation appeared near the end of 1841. Fitch published his first Report on the Insects of New York in 1855, and this was followed by thirteen others. Townend Glover began his work in economic entomology in 1854 from the smallest beginnings, and we can scarcely realize that in forty years the Division of Entomology under the leadership of such brilliant men as Riley, Comstock, and Howard, with their able assistants, should now be giving to the world such masterly reports as emanate from that center.

It is not my intention, however, to speak so much of the men as of the development of methods in economic entomology. The entomologists of the present century have given us rational methods for combating insects—methods based on a more or less complete knowledge of the entire life history of the different species of which they treated, with their natural enemies and the best artificial means for their destruction that their ingenuities could devise. It was some time in the sixth decade of this century that arsenical compounds were proposed. There was bitter opposition to the use of these insecticides for a long time, and the reports of cases of poisoning, which were said to have occurred at that time, were startling in the extreme. It was even claimed that potatoes would absorb the poison to such an extent that the tubers would carry poisonous doses, so that after each meal it would be necessary to take an antidote for the poison. There is something in the human mind that leads it to accept the dreadful more readily than the prosaic, and as many believed the fabulous stories so widely

circulated at that time, and for a long time after the advent of the beetle into the extreme east of this country, it was a common thing to see large fields of potatoes with persons of all ages and both sexes, each carrying a pan and stick with which they knocked the potato beetles off into the pan. Little by little, however, one farmer after another abandoned the "stick-and-pan" method and adopted the use of Paris green, till it came into very general use. This seemed to give it popularity, and there developed a readiness to use any kind of substance that bore the name of insect poison, till now the market is well stocked with a great variety of substances which are claimed to kill all kinds of insects. London purple followed closely in the wake of Paris green, and kerosene emulsion has also come into great favor for the destruction of the sucking insects, or such as do not eat the entire substance of the leaf. Thus we have several excellent insecticides which are in such general use that we may call the latter half of this century the period of insecticides.

There were men in past ages who were far ahead of their times in economic entomology, as well as in other departments of human knowledge. J. C. Schaeffer, in the third part of his work on the gypsy moth, published in 1761, discusses the methods of destroying this insect in a manner equal to Harris or Fitch, while Pastor Rimrod, in his paper published in 1781 on the same insect, handles the subject with equal ability. These papers were rare exceptions in those times, and probably made little impression on the public mind, because they were so much in advance of the times. On the other hand, there are men to be found in all ages who are very much behind the times, and we may even now find men who believe every invasion of insects to be an Israelitish plague sent upon us because of the sins of the people.

In 1875 Governor Harding, of Missouri, issued a proclamation appointing a day of fasting and prayer for the interposition of Divine Providence to relieve the calamities caused by the devastation of the Rocky Mountain locust. Many of us well remember the newspaper accounts of the terrible suffering and starvation in some of the Western States caused by this insect in those times, and it need not surprise us so very much if, after having tried every plan that human ingenuity could devise, they should in their final extremity have appealed to Almighty God. This is about the way with us all. In the supreme hour, when everything else fails, we remember and appeal to the Overruling Providence. If I may be permitted here to express a personal opinion along these lines, I would say that while it is exceedingly helpful to the human soul to trust in the Divine Creator of heaven and earth, I can not rid myself of the conviction that in economic entomology God helps those most who most help themselves—those who make themselves most conversant with His laws, as exhibited in the life and habits of the insects they have to deal with, as well as the climatic and other conditions which affect them, in fact the whole

environment, and make the best possible use of this knowledge in their attempts to destroy insects or hold them in check.

Last year the chairman of the board of selectmen in a Massachusetts town refused to use any of the public money for the protection of the trees along the streets from the cankerworms, because the idea of fighting insects was "agin natur." This year that same man's apple trees are as bare of leaves as though a fire had run through his orchard, and therefore I am of the opinion that it will be "agin natur" for that man to gather a crop of fruit from his trees this fall.

The establishment of agricultural experiment stations by the General Government in 1888, with entomologists in a large proportion of them, gave a wonderful impetus to the study and development of economic entomology in this country. At first it was thought that because of the lack of a sufficient number of well-trained and experienced entomologists to fill these positions very poor work would be done until a sufficient time had elapsed for young men to become educated and trained in this line, when they would crowd the more inferior material to the wall. To me it has been a matter of pleasure and pride to see the young men coming to the front so rapidly, filling these places so satisfactorily, and publishing bulletins and other papers of such rare value. I am deeply impressed with the idea that unless those of us who are older and have been in the work for a long time look well to our laurels we may soon find ourselves crowded up against the displacement wall and younger and perhaps more competent men standing ready to take our places. Nevertheless, it is a great pleasure to me to help and encourage any promising and modest young man who is thoroughly in earnest in the study of entomology.

In this connection I can not too highly commend the course taken by some of our economic entomologists who in connection with their other work make a systematic study of some family or group of insects or study thoroughly the anatomy or embryology of one or more species. Even a fragment of such study will some time prove useful, since it forms a link in the great chain of human knowledge, and each link forged into it tends to strengthen and make it more useful. I have no sympathy with those who work only in one restricted field till they become so narrow that they can appreciate nothing except what is found in their own extremely narrow groove. The entomologist who broadens the horizon of his observations becomes better able to grasp and comprehend the great problems presented to him.

With the discovery of insecticides came the necessity for various kinds of apparatus for the application of them, and here again there has been an evolution which is still going on. Many of the spraying pumps, nozzles, and other apparatus first placed on sale are no longer in use, but greatly improved kinds are on the market, and investigations are still giving us improvement after improvement, some of which, unfortunately, are no improvement at all. On the whole, however, the insecticide apparatus of to day is greatly superior to that of a decade ago.

THE FUTURE OF ECONOMIC ENTOMOLOGY.

It seems to me that in the future development of economic entomology we have need of the chemist and of the physiologist. Some work has already been done on the use of Paris green and lime, but the results do not appear to be beyond question. It is to be hoped that the investigations already made in the work on the gypsy moth, as well as those not yet completed, may prove of value in operating on other species of insects. This work has already given us arsenate of lead and arsenate of barium as insecticides, and investigations are still going on concerning the nature of the intestinal secretions of this insect and the poisons that will most readily react on these secretions and thereby destroy it. It may be that investigations by the chemist and physiologist, working together along these lines, may give us something in the future superior to anything in use at the present time. The three most important characteristics of an insecticide which must be kept constantly in mind when investigating a new or untried poison, are: (1) It must kill the insects quickly, the more quickly the better; (2) it must not injure the foliage when used in as large proportion as one may need for the destruction of the insects; (3) it must be cheap enough to come into general use. There are other considerations of more or less importance, as the ease with which the insecticide may be applied, its liability to clog the nozzles or corrode and injure the apparatus, and, in fact, any objection that will prevent the substance from coming into general use.

After one has made valuable investigations and discoveries in economic entomology it remains for him to publish his discoveries in such a place as will be accessible to those who most need this information, and in such a manner as to lead them to read the paper carefully and intelligently. I know very well that there are thousands of persons who receive our bulletins who do not even look them over. I was told by the editor of one of our leading agricultural papers a few years ago that he sent out a circular letter to his subscribers asking what changes, if any, they would like to have him make in his paper, and a large percentage of them requested him to give them more stories; and I have sometimes wondered if the information given in our bulletins were presented in the form of a strongly sensational novelette they would not get a much more general reading. Personally, I can not adopt the plan, as I have no skill as a novelist.

After all, it is more important to investigate and make new and valuable discoveries, even if they are not so widely read at first, for they will be taken up by others and disseminated far and wide, and in time the useful information will become filtered through the public mind.

There is often need of legislation to aid in the carrying out of the recommendations of the economic entomologists, and this is an important question at the present time. There is no law in Massachusetts to prevent a nurseryman or anyone else from selling and distributing

nursery stock that is infested with the San Jose scale, or of distributing and establishing colonies of any injurious insect, except the gypsy moth. Nor is there, so far as I know, any law in the land to prevent the importation of injurious insects from any other country.

I have generally felt very shy of legal enactments, because they are so often couched in language quite beyond my comprehension, and in many cases they seem to require a "Philadelphia lawyer" to interpret them, and even then two lawyers frequently differ in their interpretation of the same legal point. I am therefore of the opinion that there is need of great clearness and simplicity in the wording of an act, and also that it would be wise to have more or less uniform laws in all the States concerning those injurious insects which are, or are liable to be, generally distributed through the country. In this matter we should also consider our nearest neighbors, Canada and Mexico, for, while politically distinct from us, entomologically there is no dividing line.

In conclusion allow me to congratulate you on the growth, importance, and success of this association, and bid each and every member Godspeed and help in his chosen field of labor, assuring him that every good piece of work he may perform will not only redound to his credit, but will add to the sum total of human knowledge and human happiness.

Following the reading of the president's address, the reports of officers and committees were listened to.

The secretary presented a report in which the list of active members of the association was shown to be 78 and the foreign members 22. The same officer also presented a statement of the receipts and disbursements of funds of the association for the year.

An auditing committee of two, consisting of Mr. Smith and Mr. Hopkins, was appointed to examine the accounts, and, on motion of Mr. Smith, it was ordered to enforce the collection of the annual assessment provided for in the by-laws of 50 cents per member.

The following new foreign members were proposed and duly elected:

Mr. Charles P. Lounsbury, Department of Agriculture, Cape Town, Cape of Good Hope, South Africa. Proposed by Mr. Smith.

Mr. Fred. Enock, 21 Manor Gardens, Holloway, London, England. Proposed by Mr. Howard.

Dr. Enzio Reuter, Fredriksgatan 45, Helsingfors, Finland, Russia. Proposed by Mr. Howard.

Mr. Frederick B. Theobald, lecturer in entomology and zoology, Agricultural College, Wyecourt, Kent County, England. Proposed by Mr. Webster.

Dr. Antonio Berlese, R. Scuola superiore de agricoltura, Portici, Italy. Proposed by Mr. Webster.

Dr. Paul Marchal, chef des travaux à la Station entomologique de Paris, 16 rue Claude Bernard, Paris, France. Proposed by Mr. Webster.

Mr. W. C. Grasby, Parkside, Adelaide, South Australia. Proposed by Mr. Webster.

The following new active members were proposed and elected:

Mr. W. G. Johnson, Agricultural College, College Station, Md. Proposed by Mr. Marlatt.

Mr. E. E. Bogue, Agricultural Experiment Station, Stillwater, Okla. Proposed by Mr. Howard.

Mr. James S. Hine, Wooster, Ohio. Proposed by Mr. Webster.

Mr. C. W. Mally, Wooster, Ohio. Proposed by Mr. Webster.

Mr. H. L. Frost, Boston, Mass. Proposed by Mr. Kirkland.

On motion of Mr. Howard, it was ordered that a joint meeting be arranged between the Association of Economic Entomologists and the Society for the Promotion of Agricultural Science for the reading or presentation of papers which would be of interest to both societies. Messrs. Howard and Bethune were appointed a committee to arrange such joint meeting.

On motion of Mr. Smith, the president and secretary were constituted a committee on programme.

Mr. Howard then read the first paper, entitled:

SOME TEMPERATURE EFFECTS ON HOUSEHOLD INSECTS.

By L. O. Howard, *Washington, D. C.*

There has been a rapid increase in the number of cold-storage plants in large cities during the last few years, and there has been a corresponding development in the uses to which they have been put. A department which has grown to quite extensive proportions is the cold storage of furs, rugs, and valuable woolen goods generally during the summer months to prevent the work of the larvæ of clothes moths and clothes beetles and allied insects.

That a certain degree of cold would result in inactivity on the part of these insects was a foregone conclusion, and as a result of the general understanding to this effect the first advertisements of cold-storage firms for furs and rugs met with an immediate response from the wealthier inhabitants of our larger cities. The first trials proving satisfactory, the custom continued and grew until at present it is recognized as by far the safest method of keeping such property during the heated months, and until it has become one of the principal sources of revenue of many cold-storage companies and practically the sole source of revenue of many others. So satisfactory has it proved that the writer, in addressing the Washington Club (an organization composed entirely of wealthy or well-to-do women) last winter, did not consider it worth while to mention any other remedy against clothes moths. Had he, however, been addressing an audience of housekeepers to whom a small sum of money would be an object, other remedies would have been mentioned.

As a matter of course the expense of this process to the owners of furs and woolen goods is necessitated by the expense of operating the

cold-storage plant, and anything which will reduce the cost will enable a reduction of the charges for storage, and this brings us directly to the object of this paper.

Early in the present year the Quincy Market Cold-Storage Company of Boston, at the advice of Mr. John G. Jack, of the Arnold Arboretum, applied to the writer for information as to the exact or approximate temperature at which goods of this class should be kept in order to maintain in a state of inactivity any destructive insects which the goods might contain. It was stated that the company was in the habit of carrying eggs and fruit at temperatures ranging from 32° to 40° F. and butter and poultry at from 12° to 20°, and that recent applications for storage room for furs, felt, and different kinds of woolen goods found the company at a loss to know the necessary degree of cold. The practical importance of the inquiry appeared at once from the fact that every extra degree of cold means a more or less definite expense to the company, and they were, therefore, anxious to keep the goods at as high a temperature as would be consistent with perfect safety from insects.

Much to his regret the writer was unable to give the Boston company the definite information which it desired. He searched entomological literature for facts bearing on the subject and consulted his experienced assistants in the Division of Entomology of the United States Department of Agriculture without satisfaction, and was finally obliged to make the indefinite and unsatisfactory reply that in his opinion a temperature of not more than 40° F. would in all probability keep any of the insects concerned in an inactive condition. He advised careful experiment, and has since learned that this company has utilized the services of Mr. Samuel Henshaw, of Boston, in this experimental work, although the results are not yet known.

Soon after this correspondence and futile investigation of the literature a similar query was received from a Western cold-storage firm, and correspondence with this firm and subsequent investigation of the methods in use by other firms showed that many companies engaged in this business have not considered it worth while to inform themselves on this important point, but have, in their desire to "make a sure thing of it," kept this class of goods systematically at a most unnecessarily low temperature, and have thus practically thrown away large sums of money. As an example of the facts ascertained and as a preliminary to what follows it may be stated that a prominent Southern firm first places furs and woolens in what is called the "freezing room" at a temperature of 18° F. for a week or more and afterwards stores them permanently at a uniform temperature of 24° F.

The writer then decided that the importance of the subject well warranted experiment, and he decided to apply to some local company for facilities. At this juncture he was greatly pleased to receive a call from Dr. Albert M. Read, manager of the storage warehouse

department of the American Security and Trust Company, of Washington, who had come to consult him about certain insects found in stored woolens, and who, he found, had already begun a series of experiments in just this direction. Dr. Read very obligingly placed at his disposal a well-equipped cold-storage experimental closet which he had had constructed for his own work, and further made careful observations himself, with daily notes upon different species which were furnished to him. In addition, he has since placed at the writer's disposal the notes which he has made upon material collected by himself from goods sent in for storage.

The series of experiments is by no means yet completed, but the results already reached seem to the writer to be of such value as to deserve immediate publicity. It will not be necessary to present the notes in full, but simply the facts so far learned about each species experimented with. The writer wishes it distinctly understood that the notes upon which the statements are based have been made solely by Dr. Read, who has entered upon the investigation with an interest not entirely based upon its economic aspects.

THE COMMON CLOTHES MOTH (*Tinea biselliella*).—*Eggs.*—Recently laid eggs of this species were sent Dr. Read May 2 and were immediately placed at a temperature of 37° F. June 16 (the temperature in the interim having varied from 34° to 40°) they were taken out for examination and kept for twenty-four hours at a temperature of 78°. No change could be seen, and they were placed back in cold room, where they have since remained without hatching, at an average temperature of about 34°.

Adult.—Experiments upon adults are necessarily more or less unsatisfactory, but here is one of interest. One small bundle of rugs (4 feet long and 1 foot in diameter) out of a large consignment which was found to be swarming with moths was saved from the general cleaning and heating, was rolled lightly in burlap, and placed in test room at a temperature of 62° F. June 21, at 4 p. m., the brine was turned on. June 22, 10 a. m., temperature 32°, nearly all of the moths were dead, those alive being at middle of bundle. June 24, temperature 40°, very few were still alive, and those were inactive. June 25, temperature 31°, all were dead.

Larvæ.—None of the experiments made showed that the larvæ subjected to a continuous low temperature, even reaching to 18°, will die, although larvæ kept at from 28° to 18° for a time, then revived by warmth, and then restored to the cold temperature almost invariably died. In fact the survival at a *continuous* low temperature is shown by the following experiment:

June 18, 13 larvæ were dropped in a bit of woolen goods and placed in cold room at a temperature of 31° F. June 29, 29° to 33°. July 11, 28°. Self-registering thermometer showed 18° lowest temperature. All larvæ apparently dead. Five taken out and kept in warm room.

Two moved in fifteen minutes, one in thirty-five minutes, and the fourth in seventy minutes. No. 5 showed no signs of life at this time and was watched no longer.

Larvæ with corduroy were kept for many days under observation; at temperatures of 37°, 39°, 40°, and 42° were absolutely motionless; at 44°, 45°, 47°, and 48° were moving very slightly. Forty-eight degrees was the highest temperature reached, and between April 24 and June 15 there had been no attack whatsoever on the goods. On the latter date all larvæ were removed to warm room, when 20 out of 50 revived.

A parallel experiment on uncovered larvæ showed practically the same result.

THE BLACK CARPET BEETLE (*Attagenus piceus*).—*Adult.*—The beetle was found to move at 47° and was motionless at 42°.

Larvæ.—Larvæ of this species, which is one of the principal household insects in the South, replacing there *Anthrenus scrophulariæ*, were tested both with bits of carpet and in corn meal in which they were found. At 38°, 39°, 40°, 42°, and 44° F. they were motionless. At 45° those with meal were motionless, but one of those with cloth was seen to move its legs and head slightly. At 47° and 48° both lots moved, though very sluggishly.

Of those kept with cloth at degrees varying from 38° to 48° from May 6 to June 15 none revived after a "long time" in a warm room, from which Dr. Read made a marginal note, "Don't seem to stand long-continued cold as well as moth larvæ." With those in the meal, however, the case was different. They were maintained from May 2 to June 29 at a temperature ranging from 29° to 48°. On the latter date they were removed to a warm room and only a few revived after 75 minutes, but next day all were active.

THE LEATHER BEETLE (*Dermestes vulpinus*).—*Larvæ.*—At temperatures of 36°, 38°, and 39½°, motionless; at 40°, 44°, and 45° there was slight motion; at 47° and 48° they were active and feeding.

THE DARK MEAL-WORM (*Tenebrio obscurus*).—*Larva.*—At 36° to 42°, no movement. At 44° to 48°, slight and weak movements of legs. *Pupæ.*—Two pupæ were kept in cold room at from 34° to 48° from May 2 to May 11; were then removed to warm room. One partially transformed May 18, but died, and the other died May 25. This observation has no significance, but is included as the only one made upon pupæ except with the following species:

A CABINET BEETLE (*Trogoderma tarsale*).—*Pupæ.*—Five pupæ have been kept from May 2 to the date of writing (August 14) at a temperature of from 34° to 44° without apparent change.

Adults.—Ten beetles kept from May 2 to July 2 at a temperature of from 34° to 44°. Three died during that time and all remained perfectly inactive without ovipositing.

CONCLUSIONS.

It is regrettable that no experiments were tried with the European carpet beetle, commonly, though erroneously, called "buffalo moth" (*Anthrenus scrophulariæ*), but for some unexplained reason this insect is not known as a carpet pest in Washington, and any experiments made at that point with introduced specimens would therefore be inconclusive. It is doubtful, however, that it would be found to differ greatly in resistant qualities from the rather closely allied *Attagenus piceus*. It should, however, be definitely experimented with, unless it has already been done by Mr. Henshaw.

The experiments just summarized seem to me to show definitely that it will be perfectly safe to keep materials infested by any of the insects mentioned above during the summer months at a temperature of from 40° to 42° F., and that the average cold-storage company, if my information as to the customary temperatures be correct, has been wasting in the neighborhood of 20° of cold.

The economic entomologist is always interested to know in cases like this what the actual saving will be in dollars and cents, but in this case it is impossible to say. It is practically impossible to estimate a definite cost for each degree of refrigeration, on account of the differences in machines, in insulation of rooms, in cost of coal at different points, and more particularly on account of the increase of cost in periods of excessive summer heat. It is plain, however, that in every such establishment every degree of temperature below that of the outside air requires a definite expenditure of coal, and, therefore, a saving of 20° of actual temperature is a saving indeed.

Mr. Fernald expressed himself as much gratified with this presentation of a new and very valuable method of controlling certain of the household pests, and stated that this subject was one in which he had been much interested for a number of years. He felt convinced of the very great importance of the temperature method of control now for the first time brought prominently to the fore.

Mr. Howard suggested that in view of the increase of the expense of this treatment the lower the temperature be maintained, if previous disinfection be given articles it would doubtless be possible to keep them with safety through the summer at a temperature of 50° F. He suggested steaming, as a preliminary disinfection, wherever practicable.

Mr. Fernald was of the opinion that such steaming of goods prior to storing is now practiced in Boston by certain storage companies.

Mr. Webster presented the following paper:

THREE YEARS' STUDY OF AN OUTBREAK OF THE CHINCH BUG IN OHIO.

By F. M. Webster, *Wooster, Ohio.*

As compared with Illinois and the States west of the Mississippi and north of the Arkansas rivers, Ohio had, until 1895, never witnessed an outbreak of chinch bug. As a consequence, almost the only farmers who had any acquaintance whatever with the pest were such as had had experience with it in the States above mentioned, few others being able to recognize it when it appeared in their fields. There had been a slight attack in extreme southern Ohio in 1873, and a more severe one, located more centrally, in 1887 and 1888, but even in these cases the ravages were not so very severe, except locally. In traveling about over the State I have frequently observed it in limited numbers and learned of its previous occurrence in various localities in noticeable though not in destructive numbers from people who could only describe them as "being present at harvest time and among corn at the time of cutting and curing the fodder, and having the odor of bedbugs." It was therefore with little concern that in the summer of 1894 I noted them in limited numbers over the area indicated in fig. 1 by horizontal lines, and much more abundant where these are crossed by oblique lines. There did not appear to be any special danger, as the threatened outbreak would probably have failed to materialize had the spring of 1895 been one during which there was an average rainfall. But the season of 1895 proved a very dry one, and I fully expected trouble from somewhere, but up to June 25 no complaints were received from farmers, and I came to the conclusion that Ohio was certainly not a locality at all congenial to chinch bugs. Within two weeks, however, that opinion was entirely reversed, and hundreds of farmers appeared to discover the pest on about the same dates, and a perfect deluge of letters came pouring in, but, strangely enough, very few of them came from within the area where the pest had been observed the previous year, and consequently where they might apparently be the most confidently expected. In fig. 2 the area of attack and the relative severity are indicated as in map 1, and it will be observed that in one county only, Wyandot, was the attack as severe as during the preceding year, while over a considerable portion of the area where bugs were observed in limited numbers in 1894 we had no complaints of their appearance at all in 1895. Attention is here called to the isolated localities of occurrence that year, as these will prove of especial interest when we come to study the outbreak of the year 1896, besides indicating localities where we distributed *Sporotrichum*. The autumn of 1895 was very dry, and almost the entire fall brood of chinch bugs must have gone into winter quarters in a healthy condition. The spring of 1896 opened with

a moderate rainfall, except in the extreme southern portion, where very few chinch bugs had been reported last year, so that it was, early in the season, utterly impossible to foresee what was to follow—whether we were to have a third attack or not, and in case we did, where in the whole State we were to expect the outbreak. Farmers were apprehensive of trouble and very uneasy, especially where they had felt the

FIG. 1.—Map showing area in Ohio over which chinch bugs were observed in limited numbers in 1894: ═══: area seriously affected: ▨ (original).

effects of the ravages of the pest the year before, and to see a chinch bug on their premises was the signal for a call for aid in fighting what it was felt would, if not checked, prove even more destructive than last year. At least two farmers committed suicide on account of these troubles. We had distributed about 750 packages of *Sporotrichum globuliferum* last year, and notwithstanding that there seemed little hope of relief from this quarter in case the drought continued, we were

overwhelmed with applications for diseased chinch bugs. A change is certainly coming over the agricultural classes in their feeling toward applied entomology, as is witnessed by the fact that until quite recently when there was an outbreak of any destructive insect the farmer would simply watch the destruction of his crops with helpless concern, whereas now he writes to an entomologist to send him some

FIG. 2.—Map showing area in Ohio over which chinch bugs occurred in greatest abundance in 1895: ; area seriously affected: (from Bull. 2, n. s., Div. Ent.)

kind of disease or parasite that will destroy his enemy without further effort on his part. To supply the demand for Sporotrichum we cultivated on a mixture of beef broth and corn meal, and in this way have so far this year responded to over 1,200 requests. I mention this as indicating the fact that this year farmers were on the watch, and occurrences that in other years would have either escaped notice entirely or been ignored in case they were observed were promptly reported to us,

and will be found indicated on fig. 3 in the same manner as on the other maps. About the 10th of June we were relieved of all suspense, and it was very clear that southern Ohio would be the area ravaged this year. The reason for this is not hard to find, as up to about June 10 very little rain had fallen, and I take it that by this time the young bugs had so far developed as to be little, if at all, affected by it. This will, in some degree at least, solve the problem of the appearance of

FIG. 3.—Map showing area in Ohio over which chinch bugs occurred in 1896: ═══; area seriously affected: ▨ (original).

the chinch bug in the south in such destructive numbers this year, while the country farther north, where the hatching takes place later, escaped with little or no destruction to farm crops, except in the extreme northeast. But the perplexing feature of the problem is in that we have them this year in greatest numbers and committing the most serious depredations, for the most part, where we heard little or nothing at all of them last year. During these three years this pest has not

seriously ravaged the same area twice. The nearest to come thereto is northeastern Ohio, in Ashtabula, Trumbull, Portage, and Mahoning counties, where considerable damage was done in meadows last year, and fully as much, if not more, is being caused this year. (See fig. 3.)

The immunity from attack of chinch bug continuously enjoyed by Clark, Greene, and Montgomery counties, as also portions of other counties adjacent, I find it impossible to account for. The map of ele-

FIG. 4.—Map of Ohio, giving elevations at various points as determined by railway surveys (original).

vations (fig. 4) plainly shows that elevation was not responsible, as practically the same elevations obtain in the extreme northeast, where destruction has been caused during both of these years. More than that, the former area includes a section of level prairie country between narrow belts of timber, that has never been wooded in the history of its occupancy by the white man, and is the very place of all others where the chinch bug might be looked for during years of abundance.

Meteorological data throw no light whatever upon the problem, and I am forced to content myself with simply placing the facts upon record, leaving a solution of the puzzle to the future.

The continued ravages of this pest in Ashtabula, Trumbull, Mahoning, and Portage counties is even more perplexing, and its habits here differ quite radically from what are accredited to this species over the entire western country. Here, again, elevation offers no aid, as it does not differ materially from that of the unaffected area of which mention has just been made, and, besides, the much more closely situated counties of Summit, Medina, Wayne, and Stark, which have so far also escaped attack, have very nearly similar elevations. Precipitation or wet weather could hardly be expected to account for the unique features of this portion of the problem, and I can not find any indication of such influences. An examination of isothermal lines, however, shows that this area is much colder than any other portion of Ohio, and that in this respect it belongs in the latitude of Ontario, Canada, the temperature of northern Trumbull County being near that of the country about Detroit, Mich. While I have found the species breeding in wheat fields in Ashtabula County early in June, the date of appearance of the fall brood of young in this locality is uncertain.[1] While the species breeds in wheat, the greatest injury is here worked in timothy meadows, and not only does breeding probably take place here, also, but there are strong reasons for suspecting that it may live over winter and continue its attack a second year in the same meadow. Two or three cases have come to my notice where the attack was begun on one side of a meadow last year, and a part destroyed, ravages beginning this year where these ceased last fall, and being carried on until the remaining portion had been destroyed. At wheat-harvest, instead of going from a wheat field to corn, as is usual elsewhere, the migration is, apparently, to meadows, and I am unable to find that any material injury has been done to corn in this section of the State, and have found the bugs in cornfields but very rarely, if at all. That the species is here less nomadic than elsewhere is also indicated by the abundance of individuals of the short-winged form, fully 10 per cent of the adults in August having this character, so rarely found elsewhere to the south or west. In attacking timothy (blue grass and clover are left untouched) no attention is paid to either leaves or stem, the bulb only being attacked, so that one may pass through a meadow literally alive with bugs and not see a single one, but on drawing away the dead leaves and rubbish the surface and about these bulbs will be found as thickly populated as a small ant hill. As an indication of the gregarious habit being retained by the adults, instead of scattering as is

[1] On my return from the Buffalo meeting, August 28, a very few pupæ and an occasional adult, red and freshly molted, were observed, the greatest majority by far being fully developed. There were no young to be found and pairing was in no case observed.

usual elsewhere as soon as wings are obtained, a meadow is not attacked throughout at the same time, but the bugs appear to move in compact bodies, and one may see the uninjured portion clearly defined, the edge taking on a slight tinge of yellow, then yellowish brown, followed by the thoroughly browned and dead grass, all within a space little more than a yard in width and stretching away in an irregular course across the field, in much the same manner as is to be witnessed when bugs migrate from a wheat field to an adjoining cornfield in other portions of the State.

So far as temperature is concerned, this portion of Ohio belongs with northwestern Pennsylvania, western New York, and the southern half of Ontario, Canada, an area over which the chinch bug is supposed to be comparatively rare, even southern Michigan and northern Indiana being so far exempt from its ravages. This would place northeastern Ohio on the extreme northern border of the species,[1] and lead us to suspect that if it ever does break out in Canada in destructive numbers it will be found to ravage the timothy meadows more than elsewhere.

I have always held to the opinion that the parasitic fungus *Sporotrichum globuliferum* could only be used in a manner to offer relief to the farmer during wet seasons, and where there was a superabundance of the host insect, and though I have been severely criticised, am of this opinion still. For years I have been waiting such a combination of conditions, as they do not often occur owing to the fact that wet weather during the hatching season is fatal to a large per cent of the young, and not until the present year have my hopes and desires in this direction been gratified. To learn that a measure will fail under adverse conditions is but half satisfactory, and before one can feel at all satisfied the same measures must be tested under favorable conditions. This year I can say that, with all conditions favorable, *Sporotrichum globuliferum* has done all that Professor Snow or any other entomologist has claimed for it, but under conditions as adverse as these have been favorable the results will prove quite the reverse. While I do not find any reason for the immunity from attack this year over the area where this fungus was distributed last year, believing that this can be accounted for by peculiar meteorological conditions, it saved farmers thousands of dollars where it was used the present season. Where applied early in June, though it did not save the wheat crop, it did in many cases so reduce the number of bugs before they had advanced far into the cornfields that they were rendered powerless. In wheat fields, where an early application was made, the furrows and other depressions in the surface were soon white with diseased bugs,

[1]Since the publication of my paper in Jour. Cinn. Soc. Nat. Hist., Vol. XVIII, Feb., 1896, and later, and revised in Bulletin 69, Ohio Agricultural Experiment Station, Mr. W. H. Harrington informs me that he has a specimen taken by Dr. Fletcher, in Winnepeg, and that he has himself collected it along the seashore almost on the boundary line between New Brunswick and Nova Scotia.

and in the mellow ground of the cornfields a slight displacing of the upper surface with the foot would reveal myriads of their dead bodies intermixed with the soil. One farmer told me that upward of 1,000 neighboring farmers had visited his fields to secure dead bugs to place in such of their own fields as were infested, and I have myself seen good results from this method of introduction, taking pains to compare the conditions in such fields with those existing where Sporotrichum had not been introduced, and where careful search failed to reveal its presence.

While the practical value of this fungus has, in past years, probably been overestimated, it is to be regretted that there is at present a tendency to rush to the opposite extreme. Statements to the effect that it is of no practical value to the farmer, or that artificial introduction is useless, as when the conditions are favorable it will appear in a natural manner and do its work, are to say the least ill advised and true only under certain conditions. It is worthless to the farmer during a period of drought, or when the bugs are scattered, but it is practical and effective under conditions the reverse of these. It will sometimes appear in the fields in a perfectly natural manner, but this is uncertain, and we have here only one of many instances where science can and does facilitate and accelerate the usually slow mechanism of nature.

Mr. Fernald asked if the northern limit of the distribution of the chinch bug had been accurately determined.

Mr. Webster stated that he had received a specimen which had been collected by Mr. Fletcher in Winnebago.

Mr. Howard stated that specimens of this insect had been received from Cape Breton.

Mr. Fletcher could not give any information concerning the Winnebago specimen, but stated that the chinch bug is not an insect which has any economic importance in Canada, and that it is maritime solely, occurring also along the Great Lakes, but not in numbers sufficient to cause damage.

Mr. Fernald stated that in the years of collecting by himself and students of Orono, Me., only one specimen had been taken.

Mr. Perkins reported that it has been present for the past five years in a limited area in Vermont at Lake Champlain. It had only come to his attention the past year, and he is now investigating it. It had not previously been reported as occurring in the State, so far as he knew, but is now doing considerable damage, particularly to corn and timothy, although confined to small tracts.

In response to a question from Mr. Howard, Mr. Perkins stated that the elevation of the infested tract near the lake is not above 300 or 400 feet.

Mr. Perkins also stated that very little wheat is raised in Vermont, in response to a question by Mr. Fernald.

Mr. Webster, referring to the food plants mentioned by Mr. Perkins, stated that in northeast Ohio the damage is confined to timothy, corresponding with the experience of Mr. Lintner in New York; but in the northwestern part of the State it affects seriously wheat and corn and does scarcely if any damage to timothy. He asked if any one could explain this anomaly.

Mr. Smith wished to be informed whether the chinch-bug disease had failed to take hold successfully at any point in Ohio the present year.

Mr. Webster could not answer with any definiteness. No disease, he said, had been distributed in the vicinity of the Ohio River, and where much chinch-bug damage occurred in this district no presence of the disease was seen. He is of the opinion that the disease had taken hold wherever it had been properly distributed, the success the present year being accounted for by the very favorable weather conditions. With normal conditions or with insufficient moisture this result would not have been so marked.

Mr. Hopkins referred to the appearance of this insect in the mountain regions of West Virginia. Year before last it was a great pest in both oats and corn. This year it had not been particularly noticed. The region infested was said to be in the transition zone, and he suggested that perhaps temperature might explain the difference in habit of the insect noted by Mr. Webster. The present year his attention had been called to it in only one locality, and that in the central part of the State.

Mr. Webster stated that the chinch bug seems to require level country, and that the damage by it is insignificant in mountainous districts.

Mr. Fernald stated that the specimen taken by him was in a region where the Maine and Canadian faunas overlapped and at an elevation of about 500 feet.

Mr. Bethune knew of but a single instance of its occurrence in the Province of Ontario, and this was limited to one small district. He thought it would be much more likely to occur in Canada, if anywhere in numbers, in the region northeast of Lake Erie, which is in closest proximity to Ohio.

Mr. Howard, referring to Mr. Webster's experience in attempting to make predictions relative to chinch-bug damage, mentioned an experience of his own in this connection in 1888, when, from all conditions and in view of previous experience, he was led to state that the year 1888 would not be a bad chinch-bug year. In the spring alarming reports came from many parts of the West and he feared that his reputation as a prophet would be irretrievably lost and he prayed for rain. Early in June abundant rains came and the bugs disappeared, and his reputation was saved as though by an especial act of Providence. With reference to the occurrence of this insect in the Virginias, he stated that he had received many reports of the occurrence

of the pest from Virginia last year, accompanied with requests for the disease, but from the weather conditions he felt warranted in replying to these inquiries that the heavy rains then prevalent would probably bring about the death of the chinch bugs without artificial introduction of disease, and subsequent events substantiated this belief.

Mr. Kirkland read the following paper:

A NEW INSECTICIDE.

By A. H. Kirkland, *Malden, Mass.*

To no phase of the work of exterminating the gypsy moth has more careful attention been given than to the investigation of insecticides that might be effectively used against this insect. The entomologist, the director, and the chemists connected with the work, together with the several assistants employed in experimentation, have all devoted to this question their best effort, while the committee supervising the work have placed all possible facilities at the disposal of those charged with the investigations with a liberality that has left little to be desired. Spraying with arsenicals being the chief method of combating injurious lepidopterous larvæ, the first efforts of the gypsy-moth commission were directed toward spraying infested trees, pursuant to the recommendations of both Professors Fernald and Riley. That Paris green could not be profitably used to destroy this insect seemed at first incredible, but many careful experiments demonstrated the fact. The subsequent chemical investigations by Mr. Moulton while employed by the gypsy-moth committee, resulting in the discovery of arsenate of lead, are familiar to all present. This insecticide, which has been used exclusively in our spraying operations during the past three years, possesses a feature which is an aid and a hindrance at one and the same time. From its insolubility it may be used in great strengths without injury to the most delicate foliage, yet at the same time its effect upon larvæ, owing to the difficulty with which it decomposes, is not as complete as might be desired. Numerous experiments show that great strengths of arsenate of lead when used against the larger gypsy-moth larvæ give results hardly commensurate with the outlay, although this poison is very effective when used against the smaller caterpillars at the rate of from 10 to 20 pounds to 150 gallons of water.

During the winter of 1895–96 I was enabled to spend a few weeks in the botanical laboratory of the Massachusetts Agricultural College, studying the effects of arsenical compounds upon vegetable tissues with a view to gaining, if possible, further light concerning the cause of the injury to foliage by soluble compounds of arsenic. It was found that these soluble forms of arsenic transfuse by osmosis with the cell contents and plasmolyze the protoplasm, thus producing the death of the cells. This plasmolysis was, as might be expected, in direct ratio to the solubility and quantity of the compound employed. The objective point of these investigations was to find out what cheap arsenical

compounds would not injure foliage, and, with this as a basis, later to test the effects of the poison upon the larvæ. The arsenates of the alkalies, from their extreme solubility, were found to be debarred from use as insecticides, but in the group of alkaline earths the behavior of arsenate of barium was found to present features that would warrant a thorough test of its merits when used against caterpillars.

Unfortunately, the same legislative policy of delay that hindered an early resumption of our field operations in the spring of the present year also handicapped to a serious extent our experimental work. We were unable to begin insecticide experiments until about June 1, at which time larvæ were in the second and third molts and the opportunity for experimentation upon the younger caterpillars had passed. However, it seemed fair to infer from past experiences that poisons effective in destroying the partly grown larvæ would be at least equally as effective upon the younger and less hardy caterpillars. Experiments made with barium arsenate upon foliage showed its burning point to be at about the rate of 20 pounds to 150 gallons water. The foliage tests were made upon oak and apple. On hornbeam the burning was more marked, yet not sufficient to cause any great injury. In experimenting with larvæ a definite number of the insects was confined by means of thin cloth bags upon foliage sprayed with a known proportion of the insecticide. In the case of larvæ in the second, third, and fourth molts feeding upon foliage sprayed with 3, 4, and 5 pounds to 100 gallons water, all were dead in five days. With the fifth-molt larvæ from 10 to 20 pounds were necessary to kill all the insects in from six to eight days, showing, as in insecticide experiments of past years, that the resistance to poison increased with the age of the caterpillars. Duplicate experiments, tried after larvæ had reached maturity, gave less satisfactory results, on account of the pupation of a considerable part of the insects involved. About 200 larvæ were used in these experiments, and where any fed for four or five days upon foliage treated with the poison at the rate indicated death ensued in nearly all cases.

From results of this season's experimental work it would appear that arsenate of barium is probably the best arsenical compound yet used against the gypsy moth. A limited number of experiments upon the larvæ of *Hyphantria cunea* and *Datana ministra* showed that 5 pounds to 150 gallons were sufficient to destroy the caterpillars in from four to eight days. We simply wish to bring this poison to the notice of the association, so that it may be tested further by those who may so desire, and thus its actual merits will be demonstrated. We feel that more experimentation is absolutely necessary, and particularly the extended use of the poison on a large scale, in actual field operations, before we can get at its true value.

Mr. F. J. Smith, chemist to the committee, informs me that this poison may be prepared by a process similar to that employed in the

manufacture of arsenate of lead; i. e., by precipitating a soluble arsenate (arsenate of soda is probably the best from economic reasons) in an alkaline medium with a soluble barium salt. Barium exists in considerable quantities in nature as the carbonate (witherite). This mineral may be treated with hydrochloric acid, and soluble barium chloride results. When mixed with an alkaline solution of a soluble arsenate, barium arsenate is thrown down as a fine, flocculent, white precipitate, possessing physical qualities which render it easily suspended in water. When prepared in a wholesale manner, its cost should not greatly exceed that of arsenate of lead. In the reaction between arsenate of soda and barium chloride there is, of course, a by-product of sodium chloride (common salt) left in solution. This does not interfere with the effect of barium arsenate upon either larvæ or foliage, as shown by careful comparison of experiments with salt-free *v.* salt-containing barium arsenate.

I am inclined to the belief that where arsenate of lead or arsenate of barium is used in spraying better results will be obtained by dissolving the essential ingredients of either poison and adding them to the contents of the spraying tank, thus allowing the reaction to take place in the tank. In this manner the original precipitate is left in suspension in the tank contents, and will stay suspended longer than when dried and then remixed with water.

The discussion of this paper was deferred until the reading of a series of papers which had been arranged for during the afternoon session, covering the general subject of insecticides and practical operations with them against particular insects.

The session adjourned until 2 p. m.

AFTERNOON SESSION, AUGUST 21, 1896.

The auditing committee, Messrs. Smith and Lintner, reported the accounts of the secretary to be correct. The report was accepted and the committee discharged.

The committee appointed to arrange a joint meeting with the Society for the Promotion of Agricultural Science reported that such joint meeting would be held at 4 o'clock in the rooms occupied by the latter society, and that papers by Messrs. Hopkins, Howard, and Duggar would be presented. This report was also accepted and adopted.

As arranged for at the morning session, the following three papers were read, so that these, with the one presented by Mr. Kirkland in the morning, could be discussed together.

Mr. Marlatt read the following paper:

COMPARATIVE TESTS WITH NEW AND OLD ARSENICALS ON FOLIAGE AND WITH LARVÆ.

By C. L. Marlatt, *Washington, D. C.*

In the last volume of Insect Life, in an article on Paris green, attention was called to the very large amount of this substance now being used annually as an insecticide, amounting to 2,000 tons or more. The same matter was also briefly discussed before this association at its last meeting, at which time attention was called again to the possibility of the use of a simple arsenite of copper rather than the much more expensive aceto-arsenite hitherto employed under the name of "Paris green." The tests made with the simple arsenite of copper, or Scheele's green, last season were very favorable to this new insecticide, but were not carried out with sufficient fullness to justify its being unreservedly recommended. The present summer has been taken advantage of to give this insecticide a much more thorough test, making the trials in conjunction with the ordinary Paris green and a sample of the same which had been somewhat finely pulverized, and also parallel tests with London purple, arsenite of lead,[1] and a mixture submitted to us for experiment which consisted of a combination of arsenite of lead and simple arsenite of copper in equal proportions. With these six substances many tests were made on foliage, and by feeding larvæ on leaves poisoned at different strengths. Through the cooperation of the Division of Chemistry, also, chemical and physical examinations were also made of the several arsenicals. The results of this work are here summarized:

Foliage tests.—All of the first series of experiments to test the effect of these arsenicals on foliage were made on young and vigorous pear trees, and with freshly mixed poisons, both with and without lime. An entire tree was devoted to each experiment, the application being made most thoroughly. When lime was added the amount was equal in weight to the poison employed. The washes were applied at the following strengths:

Paris green, ord.
Paris green, pul.
Scheele's green.
} at the rate of 1 pound to 160 gallons; 1 to 100; 1 to 80; and 1 to 53⅓.

London purple, arsenite of lead, and the mixture of Scheele's green and arsenite of lead.
} at the rate of 1 pound to 160 gallons, and 1 to 100.

No injury or scalding resulted in any case, even with the very strong mixtures of Paris green and Scheele's green. The weather conditions were such as to give the applications a very fair trial.

Subsequently foliage tests were also made on peach, apple, cherry,

[1] Colored by the addition of a fraction of 1 per cent of aniline dye and styled "pink arsenite."

and cotton. The fruit trees in this series and the cotton plants were all young and vigorous. The weather conditions subsequent to the applications were favorable, as in previous experiments, no rain falling for a sufficient time to give a very satisfactory test. As before, all poisons applied were freshly mixed, and in every case lime was added equal in weight to the poisons used. The poisons were Paris green, ordinary; Paris green, pulverized; London purple, and Scheele's green. The first test was at the rate of 1 pound to 200 gallons of water. No signs of injury developed after two weeks, even on the tender foliage of peach and cherry. The applications were renewed on the same plants at the rate of 1 pound to 100 gallons of water. For a week no injury was apparent, even at this unusual strength, but after that period the leaves began to fall from the peach trees treated. The falling leaves were green and unspotted or scalded, but their connection with the stems was much weakened and the least wind caused them to fall to the ground. This falling continued for several days, in most cases resulting in the loss of nearly all the foliage. A few of the remaining leaves afterwards became somewhat scalded. In the case of the apple a scald in brown spots resulted in varying degree with the different washes, and in the cherry the injury was very slight and insignificant. No damage whatever resulted to the cotton.

The following table indicates the amount of damage caused by the different poisons:

Poison.	Peach.	Apple.	Cherry.	Cotton.
Paris green, ordinary	½ leaves lost	Very slight spotting.	No injury	No injury whatever.
Paris green, pulverized	¾ leaves lost	All more or less spotted.	Injury slight—insignificant.	Do.
Scheele's green	⅚ leaves lost	do	do	Do.
London purple	All leaves lost.	Much scalded, including edges.	do	Do.

This application was made at this unusual strength, especially to peach, with the intention of causing injury, so as to be able to determine the relative amounts. The injury resulting from the Scheele's green was not very much greater, if any, than with the Paris green pulverized, and probably resulted from the more finely divided condition of the powder, as a corresponding increase of damage is seen between the ordinary Paris green and the same pulverized. The damage by London purple in the case of peach and apple was much greater than with the other poisons.

It may be noted here that the effect of an arsenical spray on the plant is often long in being manifested. This has been previously noted in the course of experiments with these poisons conducted by the Division of Entomology in different years, and was again shown the present season in the work against the elm leaf-beetle. Trees on the grounds of the United States Department of Agriculture were sprayed repeatedly,

and showed no injury from poisons, except in the case of one or two trees, and even here very slight. Two or three months afterwards, however, or toward the end of July, many of the trees treated showed a varying percentage, not large, but yet noticeable, of the leaves which were turning yellow and falling to the ground, apparently going through the same stages of ripening and falling which is characteristic of the autumnal foliage. The effect of arsenic on the plant, therefore, seems to hasten maturity of foliage, and perhaps also of fruit. That this is prejudicial in some degree to the plant can hardly be questioned, and must be weighed against the destruction of foliage or fruit by insects to determine the advisability of poisoning.

Relative value of poisons against insects.—A large series of feeding tests were made with the arsenicals referred to above, half-grown fall webworms being used in the experiments throughout. From 20 to 50 larvæ were caged for each test and fed on leaves wetted with freshly prepared poisons. In all a total of 1,057 larvæ were used in the experiments. Fresh food was poisoned and supplied to the larvæ every day or two during the time of the experiments. The series of experiments were three times repeated in the case of Paris green, arsenite of copper, and London purple, and only once or twice performed with the other arsenicals. Against these larvæ the poisons were used at the strength of 1 pound to 160 gallons, 1 pound to 100 gallons, and, with the exception of London purple, 1 pound to 80 gallons. One pound of poison to 160 gallons was rather unsatisfactory, although of considerable destructive effect against the larvæ, causing the death within nine days of an average of 71 per cent of the larvæ with Paris green and arsenite of copper and 20 per cent with London purple. The rate of 1 pound to 100 gallons was eminently successful with all the poisons except London purple, which seemed to be inferior to the others and to vary greatly in the different samples. Very little difference was shown between the arsenicals with and without lime, and as between ordinary Paris green, pulverized Paris green, and arsenite of copper there is little to choose in the matter of effectiveness. Arsenite of lead, which I believe has not hitherto been used as an insecticide, gave an excellent record and seemed to be, if anything, more rapid in its action than the other arsenicals.

In the tests at the rate of 1 pound to 80 gallons of water all the larvæ were killed within seven days, no essential variation being shown between the four poisons used, viz, Paris green (ordinary and pulverized) and arsenite of copper and arsenite of lead, both with and without lime.

The following table includes the later tests at the strength of 1 pound to 100 gallons of water, and is introduced to illustrate the details of the result. Except with London purple, the larvæ were all killed within nine days, and for the most part had succumbed within six days. The slower and inferior action of the London purple is clearly shown.

Arsenicals.—1 pound to 100 gallons of water, with and without lime.

No. of experiment.	Poison.	Number of larvæ placed on poisoned food.	Number of dead larvæ after 4 days.	Number of additional dead larvæ after 6 days.	Number of additional dead larvæ after 9 days.	Total killed.	Number of living larvæ after 9 days.	Per cent killed.
43	Paris green, ordinary, with lime	20	10	10	.....	20	.....	100
55	.....do	44	9	35	.....	44	.....	100
	Total	64	19	45	.....	64	.....	100
44	Paris green, ordinary, without lime	19	12	7	.....	19	.....	100
56	.....do	44	.....	42	2	44	.....	100
	Total	63	12	49	2	63	.....	100
45	Paris green, pulverized, with lime	18	7	11	.....	18	.....	100
57	.....do	60	40	20	.....	60	.....	100
	Total	78	47	31	.....	78	.....	100
46	Paris green, pulverized, without lime	19	15	4	.....	19	.....	100
58	.....do	55	26	29	.....	55	.....	100
	Total	74	41	33	.....	74	.....	100
41	Arsenite of copper, with lime	19	14	5	.....	19	.....	100
53	.....do	40	12	28	.....	40	.....	100
	Total	59	26	33	.....	59	.....	100
42	Arsenite of copper, without lime	20	18	2	.....	20	.....	100
54	.....do	45	32	13	.....	45	.....	100
	Total	65	50	15	.....	65	.....	100
39	London purple, with lime	17	.....	10	5	15	2	88
51	.....do	50	7	29	13	49	1	98
	Total	67	7	39	18	64	3	96
40	London purple, without lime	16	4	11	1	16	.....	100
52	.....do	48	7	21	19	47	1	98
	Total	64	11	32	20	63	1	96
24	Arsenite of lead, without lime	20	.....	20	.....	20	.....	100
26	.....do	19	4	5	10	19	.....	100
	Total	39	4	25	10	39	.....	100

Much of the variation in the length of time necessary to effect the death of larvæ is explained by the condition of the larvæ. If they are just molting or about to molt, a day or two will be lost, and it may happen that when they are put on poisoned food, not relishing it, they refuse to eat before molting, so that two or three days may intervene before they feed at all heartily on the poisoned food. In the case of these experiments it was very evident that the larvæ detected almost immediately the fact of the unnatural condition of the foliage, refusing to eat or eating very scantily, whereas larvæ placed at the same time on unpoisoned food fed with great freedom and greediness. These results explain the apparently slow action of poisons on larvæ which every experimenter has witnessed. It simply means that the larvæ dislike the poisoned leaves and refuse to feed until forced to by extreme

hunger. In the meantime, however, the protection to the foliage is just as great as though the larvæ were killed outright.

Confirmatory of the efficacy of the arsenite of lead are some experiments conducted on the grounds of the Department against the bagworm on *Arbor vitæ*. Some half dozen trees thickly infested with these larvæ were sprayed at the rate of 1 pound to 50 gallons of water. Ten days after the application the cases of the bagworms were invariably found to contain dead larvæ, and the cessation of feeding of these larvæ was almost immediate after the application. The use of these arsenicals on pear and cherry trees was also accompanied by a demonstration of value as protective applications, in that trees not included in the experiment were much eaten by the pear slug.

Notes on the composition and other characteristics of the arsenicals.—A great many analyses of the old arsenicals, Paris green and London purple, have been made and are valuable for comparison. Paris green is a definite chemical compound and should have a nearly definite composition. London purple is a waste product and naturally shows considerable variation in composition. Dr. Lintner quotes an analysis showing 43.65 per cent of arsenious oxide in this insecticide, whereas other analyses have shown it to contain as little as 19.64 of arsenious oxide. Scheele's green, theoretically, should contain 52.94 per cent arsenious oxide, and the lead arsenites and arsenates occur in several different forms and have a variable component of arsenious oxide. The common form of lead arsenite contains 47.03 per cent; the arsenate such as used by the gypsy moth commission 28.53 per cent, and the lead arsenite used in my own experiments shows by analysis 39.34 per cent of arsenious oxide. In other words, Paris green and Scheele's green are not widely different in the active principle. Lead arsenite in its most poisonous form approaches somewhat closely these two, whereas the arsenate is very much weaker and yet costs more to manufacture. The following solution tests of these arsenicals have been kindly made for me by Prof. George Patrick, of the Division of Chemistry:

	Grains per gallon.
No. 1. Paris green, ordinary	0.87
No. 2. Paris green, pulverized	1.18
No. 3. Arsenite of copper	2.50
No. 4. London purple	7 93
No. 5. Arsenite of lead	94

The samples were mixed with Potomac water at the rate of 1 pound of the powder to 100 gallons of water, kept in contact for twenty-four hours, with frequent shakings during the first ten hours. The quantities of arsenic dissolved are indicated by the figures given above.

The solubility of the poison depends, as might have been expected, on the fineness of the powder, as indicated by Paris green, ordinary and pulverized. The greater amount of soluble arsenic in No. 3 is not more in the same proportion relative to its greater fineness than between the two samples of Paris green. The great solubility of London purple is shown, and also the slight solubility of the arsenites of lead. The conditions of the experiment represent an exaggeration of what might occur in spraying operations.

Paris green, ordinary, is a rather coarse crystal, and settles very rapidly in water solution. London purple is pulverulent, and settles slowly. The lead arsenites and arsenates are precipitates, very pulverulent, and settle much more slowly than even London purple, and in this category also comes arsenite of copper, which is quite as satisfactory in this respect as the lead poisons. The attempt to pulverize Paris green was only partially successful. The powder was noticeably finer than the ordinary product, but still settled very rapidly in water. The fineness of division of the poison, as indicated in the foregoing experiment, has an effect also in making it more poisonous to plants, but this may be overcome by the use of lime, and it will probably prove that a less amount of the more finely divided poison will accomplish as much as a greater amount of coarser powder.

The cost of these arsenicals varies with the market price of the constituent elements, as bluestone, arsenic, lead, etc. The price of Paris green ranges pretty close to 20 cents per pound. Arsenite of copper or Scheele's green can be made for 10 cents per pound, and the arsenite of lead (pink arsenite) prepared for our use can be made for about 8 cents per pound.

Conclusion.—Results of experiments with these arsenicals during the past few years have demonstrated to the satisfaction of the writer the value of the simple arsenite of copper, and the experiments of the present year also show the very considerable value of the arsenite of lead. Both have a very decided advantage in their more fine division, which render their use much more safe than an insecticide which rapidly settles to the bottom of the tank, resulting in likelihood of great inequality in strength as sprayed on the trees. Both of these arsenicals may be obtained at about one-half cost of Paris green, or approximately the cost of London purple, and are both of them far superior to London purple in effectiveness and in safety when applied to foliage.

Half the cost of Paris green or aceto-arsenite of copper, as has been previously pointed out, comes in making it more suitable for a pigment, its original market use, and this adds nothing to its value against insects. I think the time has come when we should abandon its use as an insecticide and substitute for it Scheele's green. This arsenical will be manufactured in any quantity by the Adler Color and Chemical Works, of New York City, and as there is no secret about its composition it can also be made by any firm working in such material.

Arsenite of lead is a most promising insecticide. The only objection to it now is the fact that it may be made in several different forms having varying percentages of arsenious oxide. Further work with this substance is now being conducted, which, it is hoped, will demonstrate a method of producing it even more cheaply than that now employed and at the same time give a guaranty of uniformity in composition. It may be colored, as in the sample exhibited, to prevent its being mistaken for harmless substances.

Mr. Howard read the following:

ON THE FUTILITY OF TRUNK AND CROWN WASHING AGAINST THE ELM LEAF-BEETLE.

By L. O. Howard, *Washington, D. C.*

When the elm leaf-beetle made its first serious outbreak in New Haven, Conn., in the early summer of 1895 the authorities were unprepared and the seriousness of the matter did not enforce itself until the damage was practically done. It was then too late to spray, and, in fact, no apparatus was ready. They immediately, however, as the writer stated before this association last year, began extensive work with kerosene emulsion upon the larvæ on the lower part of the trunk and about the base of the tree. Nearly 14,000 elms were treated in this way by the superintendent of parks, and many barrels of standard kerosene emulsion were made under his supervision and distributed to citizens who came for it with buckets to use upon trees in their private grounds. It was considered that the scale upon which this work was done was so great that it would exercise a very considerable influence upon the number of the beetles during the summer of 1896. That it did exercise a certain amount of such influence can not be doubted, but that the insect can be kept in check by such means is entirely negatived by the number of insects which successfully hibernated and laid their eggs upon leaves the present season. In the discussion of Dr. Lintner's very interesting paper upon "The elm leaf-beetle in Albany" at our last meeting Dr. Lintner stated in regard to the published accounts that many of the larvæ had dropped from the tree instead of traveling down the trunk, although the idea seemed reasonable it was not confirmed by his observations. He instanced a Scotch elm upon his own grounds which has long and somewhat drooping branches which extend over an extension of the house, but he was not able to find at any time during the season a single larva or pupa upon the roof of the extension, although fallen leaves in corners offered convenient resting places for them. Nor had he noticed in all of the hours that he passed under the elms in his study of the insect one of the larvæ upon his clothing or known it to occur upon others. Referring to this statement, the writer in the course of his discussion remarked that in his opinion not above 60 per cent of the insects upon large trees crawl down the trunk to the ground, the others falling from the branches direct or undergoing the transformations upon the rough bark or upon larger trees in the main crotches. In this statement the writer was corroborated by Mr. Smith, who further stated that he had known them to climb fences and transform in the crevices.

The statement made at the last meeting that not above 60 per cent of the insects crawl down the trunks of large trees under normal conditions, although it seemed to the writer to indicate an estimate which was about correct, must be altered, as the result of certain observations

made the present summer in the Hudson River valley. The alteration, however, is not in the direction of the statement made by Dr. Lintner, but in the opposite direction. These observations were greatly facilitated by the condition of affairs which exists in the city of Kingston, Ulster County, N. Y. There the plan has been to plant trees of different varieties in an alternating manner. Instead of a solid row of elms, there will be a row of elms alternating with sugar maple. The trees being planted rather closely and the elms growing to much greater height and frequently reaching over the maples, afforded an opportunity for testing this matter which does not usually exist along streets in cities. My attention was first directed to the extraordinary numbers in which the insects were transforming high up on the trunk. The trees were mainly old, the bark being rougher than common, and a close green moss had grown over large sections of the trunk. Embedded in this green moss and in the crevices in the bark were thousands upon thousands of the yellow pupæ. These observations were made July 10. Climbing upon a tall fence and examining the crotches of one of the largest of these trees, the pupæ were found in such numbers that they could have been scraped up by the handful. Examination of the surface of the ground at the base of the tree showed perhaps one-fifth as many pupæ as were to be found upon the trunk of the tree high up and in the main crotches. This, in itself, would indicate the almost total futility of any wash applied to the lower part of the trunk and upon the ground about the base of the tree. Further observations of equal interest and which make the case still stronger were soon made. The writer's attention was attracted to the yellow pupæ of the elm leaf-beetle in the crevices in the bark of a maple tree standing between two elms. He ascertained without doubt that it belonged to this species, and upon search found many others. The branches of the elms overhung the maple, and the inference was plain that the larvæ dropped from the terminal branches of the elms, descended the maples, and transformed at the first convenient point. Many such cases were observed. The most interesting case, however, was still to come. Upon the grounds of one of the wealthy citizens on one of the principal avenues, a low-growing horse-chestnut tree, perhaps 25 years old, with the usual shaggy bark, was noticed. At almost equal distances from this horse-chestnut stood three large old elms, each about 30 feet from the chestnut. The terminal branches of each of these elms interlaced and overhung the top of the horse-chestnut tree at a distance of perhaps 20 feet above its tip. An examination of the trunk of this horse-chestnut showed the pupæ of the elm leaf-beetle by thousands and thousands, under the loose bark which afforded particularly appropriate places for pupation. Few, if any, had reached the ground. The trunk of each of the elms in question was examined and the ground around the base of each as well, with the result that upon the trunk of the horse-chestnut tree were more than twice as

many (at an estimate) of the pupæ as were to be found upon any one of the elms. It must be remembered that but a small portion of the circumferential growth of the top of each elm overhung the horse-chestnut. Perhaps the portions of the three tree tops so overhanging would constitute a third of the arc of a circle. It at once becomes evident that in the case of these three elms nothing like 60 per cent of the larvæ descended the trunk of the tree upon which they were raised, and, in fact, that only about one-half of this percentage was correct in this case. Fully 70 per cent must have dropped from the limbs.

I do not pretend to say that this instance was not unusual, but that it demonstrates the vast superiority of spraying over all other means of fighting the elm leaf-beetle more forcibly than it has previously been shown can not be doubted.

Mr. Marlatt read the following paper:

INSECTICIDE SOAPS.

By C. L. Marlatt, *Washington, D. C.*

The decided insecticide value of the so-called whale-oil (more properly fish-oil) soaps against scale insects particularly has been fully demonstrated in the last few years in the work against the San Jose scale, and has fully substantiated Professor Comstock's early recommendation of this means of controlling scale insect pests. The merit of these soaps is not only in their effectiveness as insect destroyers, but from their being entirely without injurious effect on the treated plant. In this respect they are perfectly safe in the hands of any person, in contradistinction to all oily washes, which are very liable to be injurious in greater or less degree, although the injury may be insignificant, or perhaps not apparent immediately, or during the first season. As pointed out at a previous meeting of this association, and also in the bulletin on the San Jose scale issued by the Division of Entomology, United States Department of Agriculture, the use of soaps is attended with certain hitherto unavoidable difficulties. It seems impossible to secure with any degree of certainty soaps which may be depended upon to behave in the same manner when dissolved for application as a paint to trunks of trees, or in a spray for application to the entire plant. During the past two years we have been making a strong effort by correspondence and personal interviews with leading soap makers of Washington, Philadelphia, and New York to get a suitable soap, uniform in composition and behavior, which could be relied upon, but so far with indifferent success. The leading Washington soap maker after one trial refused to bother further with fish-oil soaps, on account of the disagreeable nature of the oil and the vile odors engendered while working with it. Some half dozen samples each have been

received for experimental purposes from William H. Pinner, of New York City, and James Good, of Philadelphia, and we have had a number of proprietary insecticide soaps, testing also some common brands of washing soaps for purposes of comparison.

Assuming that one has received a brand of fish-oil soap from an honest manufacturer, to be satisfactory for insecticide use it must when dissolved at the desired rate, say 2 pounds to the gallon of water, remain a liquid capable of being sprayed with an ordinary nozzle at an ordinary temperature. The presence of water in the soap, which is a most variable quantity, should also be approximately known to enable one to determine the amount of soap to use to make a correspondence with the standard of strength.

The experiments with soap have been in the direction of testing, therefore, first, the physical properties, viz, when dissolved if it would remain in liquid form; second, the percentage of water in the soap, and third, the constituent elements of the soap, so far as could be determined by chemical and other tests.

The first proposition, whether the soap would remain liquid when dissolved at the strength employed, may be determined by a very simple test and one which should be invariably given any soap before it is accepted for spraying operations. It consists in simply dissolving a small quantity of the soap at the desired rate and allowing it to cool. Some 18 soaps were subjected to this test, dissolving them at the rate of 2 pounds to the gallon. Nine of these stood the test satisfactorily, remaining liquid even when subjected to low temperatures in a refrigerator, and nine solidified or became gelatinous and tenacious at high summer temperatures. All but two of these soaps were especially manufactured for insecticide purposes. Among the soaps sustaining satisfactorily the solution test were the old whale-oil soap (Leggett Bros.); three of the Pinner brands, including his concentrated chemical soap; a light-colored fish-oil soap made by Good, and a potash soap made by the same manufacturer, at my earnest request several times repeated. The other soaps proving satisfactory in this respect are fir-tree oil soap (Stott's), tobacco soap (Rose & Co.), and a soap made at the United States Department of Agriculture with potash. Some of these soaps were very hard, as the Leggett whale oil, Pinner's concentrated chemical, and the light-colored soap made by Good. The rest were not so hard, and Good's potash soap was almost a soft soap, although the water percentage in it was not very much greater than some of the hard soaps.

Among the soaps resulting in a gelatinous or nonfluid mass with the solution test were three of the lots of alleged fish-oil soap submitted by Good at different dates; the Pinner chemical tobacco soap; another tobacco soap, manufacturer unknown, and two washing soaps, the "Star" and "Babbitt." One of the soaps made by Good (No. 6) was dissolved at the rate of 8 pounds to the gallon and dried down to a

thoroughly firm soap, approximately one half of the added water being lost. This product was afterwards shown to contain 48 per cent of water, and yet on diluting it at the same rate as the other soaps it solidified on cooling, showing a very strong tendency in this direction.

The opposite results obtained with different products of both the Good and Pinner factories indicate the total unreliability of the insecticide soaps at present obtainable and the necessity always of a preliminary test before using, or, better, before buying a soap in quantity, as well as the very urgent need of some action which will put within our reach a reliable article.

The second examination, viz, the percentage of water contained in soaps, was determined for me for eight brands by Professor Patrick, of the Chemical Division, United States Department of Agriculture. The samples submitted to Professor Patrick included five of the soaps which remained liquid at 2 pounds to the gallon and three that became solid. Eliminating the soap referred to above which contained 48 per cent of water, although still a soap hard enough to cut and handle easily, the per cent of water in the other soaps ranged from 9.40 in the Leggett whale oil to 28.30 in the potash soap made by Good.

The percentages of water in the soaps which were liquid in the solution test are as follows:

Whale oil (Leggett)	9.40
Concentrated chemical (Pinner)	11.60
Lye soap in bulk (Pinner)	14.80
Light-colored soap (Good)	22.30
Potash soap (Good)	28.30

The percentages of water in the soaps which solidified after the solution test are as follows:

Tobacco chemical (Pinner)	21.80
Fish oil in bulk (Good)	22.90
Fish oil in bulk (Good), treated as above described with water	48.00

The last sample shows that the per cent of water in soap has very little to do with its remaining fluid when employed at the strength indicated, this sample having 48 per cent water solidified, whereas the whale-oil soap, having the least water (9.40), remained liquid. It indicates also very clearly that much money may be unwittingly spent for water in the purchase of soaps unless they be previously tested in this direction.

It is well known that potash tends to make a soft soap and soda a hard soap in combination with oleic acid, which exists in most fats and enters largely into the composition of soaps. The presence of stearin, however, will have a marked influence on the quality of the soap, making it harder with potash and very hard with soda. Soaps, therefore, made with fats containing much stearin, such as mutton and beef tallow, and also some of the vegetable fats, will be very hard. The solubility of soaps in water, in the above combinations with potash or soda and oleates or stearates, ranges from a soap made with potash and

oleates of 1 to 4 of water to a soap made with soda and stearates of above 1 to 40 of water.

The first explanation that suggested itself of the difference in the behavior of the various insecticide soaps tested was the very natural one, under the supposition that they were fish-oil products, that it was due to the manufacture of the soaps in some instances with potash and in others with soda, the former being liquid in solution and the latter solidifying. The chemical examination of these soaps, however, failed to support this theory and showed that in every case the soaps examined had been made with soda with the single exception of the one made at my special request by Good with potash. Many of these soda soaps, including the Leggett whale oil, were thoroughly satisfactory with the solution test. The correct explanation undoubtedly is that the solidifying of certain brands of soaps is due to the admixture with fish oil, if the latter be used at all in these instances, of more or less waste beef or mutton tallow. It may be possible that there are other reasons for this condition which have not been discovered, but the above seems to be the important one. The result of the chemical examination and physical test seems to indicate one thing at least, that whether made with soda or potash, if fish oil, which is almost wholly olein, be used the product will stand satisfactorily the solution test. If, therefore, we can have a guaranty that a soap is altogether fish oil and properly made, the kind of lye employed is not absolutely essential, although the potash product is the more desirable.

The statement made in a former communication on the subject of soaps that very little water would enter into the composition of a well-made article is confirmed by these analyses, made by Professor Patrick, which show an average of less than 20 per cent water, and with the better brands between 10 and 15 per cent, the balance being the lye and fats.

The result of the investigation of this subject indicates that a fish oil or other oily soap should be invariably demanded and the desirability of giving a sample of the soap secured from a manufacturer a solution test before purchasing on a large scale, or preferably demanding a product which will stand such test. The determination of water constituent of soaps is difficult and can ordinarily only be made satisfactorily by chemists, and while desirable for accurate work may perhaps be ignored if the soap is a good, firm one and stands the solution test properly. It would seem also advisable to have the station chemists of the different States empowered to inspect and certify the qualities of any soap manufactured and sold for insecticide purposes.

In discussion, Mr. Fernald referred to the statement of Mr. Marlatt that poisoned foliage seemed to be repugnant to larvæ, and stated that the experience of the gypsy moth committee did not seem to bear out this view. He called on Mr. Kirkland to give the facts as brought out in the work of the gypsy moth committee.

Mr. Kirkland described these experiments, which were quite varied and included the poisoning of portions of leaves or of one or both surfaces, and also tests with larvæ of different ages. The result of the whole series would seem to indicate that the presence of the poison was not noticed by larvæ and had little if any effect in deterring them from feeding.

Considerable discussion followed, various members supporting both sides of the question.

Mr. Smith stated that his experience was confirmatory of Mr. Marlatt's, and he had noticed the same repugnance in the case of the elm leaf-beetle. He was quite inclined to agree with Mr. Marlatt that this repugnance, due to the presence of poison, is the explanation of the slow action of arsenicals, which is of rather common experience.

Mr. Fernald explained that the experiments under his direction had been with the larvæ of the gypsy moth, which in this and other ways manifest characteristics and powers of resistance widely different from other larvæ.

Mr. Johnson described an experience which he had had with the apple leaf-skeletonizer, attended with similar manifestation of repugnance of the larvæ to poisoned leaves. He described feeding experiments in cages in which 100 larvæ were included in each cage and fed with leaves poisoned at a definite strength. In one instance the larvæ refused to feed for three days.

Mr. Webster, referring to the statement concerning the use of oily washes on trees by Mr. Marlatt, described an experience with the use of pure kerosene on peach trees for the San Jose scale in Ohio. The trees had been cut back rather severely and were in December sprayed thoroughly on trunk and branches with pure kerosene. Upon examination in March these trees were in thrifty condition and presented no injury from the application. He was so pleased with the results that he purposes to recommend the use of pure oil, and stated that many orchards would probably be sprayed with this substance the ensuing winter. He further called attention to the fact that the Bordeaux mixture sprayed on plants often afforded protection by rendering the foliage distasteful in much the same manner as an arsenical. He instanced particularly the benefits of Bordeaux as a means of protecting potato vines from the attacks of *Diabrotica vittata*. He referred also to the fact that no general deductions can be made from the habits or behavior of any particular insects with poisons, and that with different species vastly different results are to be expected. He referred to his experience with the grapevine Fidia, which he had kept in a breeding cage through which a living grapevine was passed which had been poisoned with arsenicals at the rate of 4 ounces to 50 gallons. The beetles lived for several days on this poisoned food. He referred also to the fact that the different results obtained with the same insect are not always due to faulty material, but rather to the men who make the

applications, since farmers are highly unreliable and can very rarely be depended upon to make applications properly.

Mr. Fletcher agreed with Mr. Webster as to the variability manifested by different insects under treatment with insecticides, instancing as a striking case in point the gypsy moth. He spoke of the great value of the work of the gypsy moth committee, particularly as brought together in the recently published report, which contains much that is of interest on this and other subjects. Referring to the value of Bordeaux mixture as a means of protection, he said that he had found it quite effective against Crepidodera (?) when Paris green failed entirely. He also referred to the use of lime with Paris green and the value of this combination as a safeguard against scalding.

Mr. Kirkland, referring again to the experience of the gypsy moth committee, stated that results seemed to indicate no value whatever from the combination of lime with Paris green. The lime, if it had any action, would simply break down the Paris green.

Mr. Howard suggested that the action of lime in determining the effect of the arsenical on foliage and larvæ would depend largely on the amount of lime employed.

Mr. Fletcher agreed with the probability of the amount of lime used being important and asked for information as to the exact proportions that had been found to be most desirable.

Mr. Smith stated that the amount of lime necessary to be employed to neutralize Paris green had been experimentally determined by the chemist of the New Brunswick Station, and that he had published the data in a report of the station. He was convinced that the benefit of the addition of lime to arsenicals had been demonstrated beyond question, and he had always so recommended it.

Mr. Fernald stated that he formerly agreed with Mr. Smith as to the desirability of the use of lime and had recommended its use up to the time of these experiments. He asked Mr. Forbush for his experience with the use of this arsenical with or without lime.

Mr. Forbush stated that his experience was that it made very little difference whether lime was added or not. In some instances results were less satisfactory with lime than where it had not been added. In some instances, also, foliage was burned most where lime had been used. He stated that he had early discontinued the use of lime with arsenicals in work against the gypsy moth.

Mr. Smith stated that he had constantly recommended the use of lime in correspondence and publications and felt that its addition to arsenicals was of decided value.

Referring to the subject of insecticide soaps, Mr. Smith stated that he had found the same difficulties mentioned in Mr. Marlatt's paper on the subject, and in some instances where the soaps had been used no beneficial results had followed whatever, to the very considerable discouragement of farmers who had gone to much expense to procure

materials and make the applications. He was convinced that to get good results it will be necessary for each farmer to make the soap for himself. He had found also that Leggett's soap was excellent in quality and thoroughly satisfactory, killing the scales completely, but that it was much too expensive for practical use on a large scale. He said that some farmers have already had very good results with soaps made by themselves. He was of the opinion that as a rule farmers will be quite willing to undertake the manufacture of soap, especially as they would be in the majority of cases more willing to assume the trouble of manufacture rather than go to the expense of purchasing soap from some dealer. In California a soap containing a definite composition is demanded, and a method of determining the amount of moisture, viz, by drying, is practiced.

Referring to the recommendation of Mr. Marlatt of the arsenite of lead in preference to the arsenate, Mr. Smith further stated that the easy preparation of the latter is an argument in favor of its use by farmers, the preparation of the arsenite being more difficult and attended with some risk of poisoning if undertaken by persons unfamiliar with the precautions necessary. Referring to Mr. Webster's report of the use of kerosene pure on the trees, he was of the opinion that such application would kill the trees outright.

In answer to a question from Mr. Howard, Mr. Smith stated that wetting the bark of trees with kerosene and firing it to kill scale insects had in his experience been satisfactory and had not worked injury to the plants. The treatment can only be made on an absolutely calm day. With even a little breeze blowing the kerosene will not burn on the windy side. On smooth-barked trees where the bark is green and healthy the kerosene will not burn at all, and it is only on trees that have a certain amount of dead surface bark or have it covered with lichens, mosses, or the like that one can get any satisfactory burning. Practically the measure is useless except on old trees.

Mr. Kirkland, referring to the common method of preparing arsenate of lead, stated that if the crude acetate of lead be used, which is considerably cheaper than the refined article, it will be necessary to dissolve it in warm water, as it will not dissolve readily in cold water. He also referred to the danger of arsenical poisoning attending the manufacture of arsenite of lead by farmers and others who are not used to handling the substance and are not supplied with proper apparatus.

Mr. Lintner, referring to Mr. Howard's paper on the elm leaf-beetle, stated that he still held to his former conclusions that the larvæ of the elm leaf-beetle do not drop to the ground in any numbers. He was not by any means convinced that the case referred to by Mr. Howard of the presence of pupæ on horse-chestnut was at all conclusive. He said that the larvæ have a very great climbing tendency, instancing a number of cases corroborating this fact. He had taken in one instance no less than 21 larvæ from a deserted cocoon of Orgyia on the trunk of a tree. He said that there was an undoubted second brood of the elm

leaf-beetle at Albany the present season, and described the circumstances attending its appearance. In this instance the second brood of larvæ appeared on the trees which had not been attacked by the first brood.

Mr. Smith said that he had found, the present season, no trace of a second brood at New Brunswick, N. J., although everything was favorable for the appearance of a second brood, in view of the presence of many trees in good foliage. The trees on the grounds of the college campus were this year in exceptionally superior condition. He referred also to the discovery of larvæ and pupæ under the bark of other trees than elm, and supported Mr. Howard in his conclusions. There was abundant opportunity for the appearance of a second brood, but, in point of fact, the beetles had already practically disappeared into their hibernating retreats.

Mr. Howard, in answer to Mr. Lintner's criticism, stated that he saw larvæ descending the horse-chestnut from a point above the main crotch, and further stated that the intervening ground space between the elms and the horse-chestnut was covered with close, short grass, so that it was out of the question for the larvæ to have reached it in any way except by falling on it from the overhanging elm branches. No other explanation was possible. He referred also to the case reported by Mr. J. W. Clark at the last meeting, where the branches of an elm extended over a house, which had also no other possible explanation than that the larvæ fell directly from the branches to the ground.

Mr. Johnson stated that at the Maryland Experiment Station, by order of the chemist, Mr. Patterson, bands of dendrolene had been put about the trunks of elms in the station yard to keep the larvæ from ascending. Mr. Patterson stated that he had observed larvæ ascending the trees, but, after the application of this lime, they accumulated about it or would fall back to the ground and could then be easily destroyed.

Mr. Howard stated that the second brood of the elm leaf-beetle was very small this year in Washington. His explanation of this fact was that the first brood had not been large and there had been comparatively little damage to foliage, so that when the second brood arrived there was no second crop of new tender leaves to induce them to oviposit, the results in this respect being entirely different from last year, when the first generation was large and entirely defoliated many trees, and the consequent throwing out of a second crop of leaves induced the beetles to oviposit it for a second generation. With regard to the distribution of this insect, Mr. Howard said that he had found it abundant at Troy, and the farthest northern limit so far discovered for them was Mechanicsville in the Hudson River valley.

Mr. Fernald said that they were not increasing at Amherst, and were no more abundant this year than last at that point.

MORNING SESSION, AUGUST 22, 1896.

The following new members were proposed and duly elected:

M. F. Adams, Buffalo, N. Y. Proposed by Mr. Slingerland.
Lewis Collins, Brooklyn, N. Y. Proposed by Mr. Howard.
W. E. Rumsey, Morgantown, W. Va. Proposed by Mr. Hopkins.

On motion of Mr. Smith, the chair appointed a committee consisting of Messrs. Smith, Lintner, and Forbush to nominate officers for the ensuing year.

The following paper was read by Mr. Smith:

SCALE INSECTS AND THEIR ENEMIES IN CALIFORNIA.

By JOHN B. SMITH, *New Brunswick, N. J.*

[Author's abstract.[1]]

So much has been published on the subject of the beneficial effects of predaceous insects introduced into California to destroy injurious scales that the farmers of New Jersey felt as if a similar method should be at least tried in New Jersey to rid them, if possible, of the San Jose or pernicious scale.

The matter was discussed in the Horticultural Society and in the New Jersey State board of agriculture with the result that an appropriation was made by the legislature of the State for the purpose of investigating the scale in California and for introducing into New Jersey such of its enemies as might offer a fair chance of being beneficial and of maintaining themselves in its climate. The investigation was made in May and June, principally in the southern parts of California, and covering the fruit-growing regions as far north as Marysville, in the Sacramento Valley. Specifically, the points touched were Los Angeles, Santa Barbara, Elwood, San Diego, National City, Riverside, San Bernardino, Ontario, Pomona, Clermont, Pasadena, San Francisco, Berkeley, San Jose, Mountain View, Palo Alto, Sacramento, and Marysville.

Throughout the State, or rather wherever examination was made, the San Jose scale was still found to be present in more or less considerable numbers; but south of San Francisco it was nowhere found in troublesome quantities. North of that point, except in the immediate vicinity of San Francisco, the scale was still a dangerous and troublesome insect and was kept in check only by persistent work on the part of the growers, the favorite remedy being the lime, sulphur, and salt wash. This seems to be entirely satisfactory as used in California, and in the Marysville region, that is, in Yuba and Sutter counties, every grower sprays his orchard, no matter how large. Thousands of fruit trees are sometimes massed together, and tons upon tons of the

[1] The full account of this subject will be found in the Annual Report of the New Jersey State Experiment Station for 1896.

mixture are used by a single farmer. The process is expensive, of course, but the results are good, and without it the orchards would be valueless. It is claimed that especially on peach the lime, sulphur, and salt mixture acts as a fungicide, and prevents leaf curl, while apparently strengthening the tree and enabling it to better retain the set of fruit. In the immediate vicinity of San Francisco and south of that point, natural causes have resulted in keeping the pernicious scale in check. In the first place the scale has the appearance of becoming worn out; that is to say, there are a great many dead specimens to be found on the trees—the young themselves, when moving about, appear as if they were only half alive—and altogether it seems as if there was some force at work that is weakening the insect. It is also preyed upon by *Chilocorus bivulnerus* in all its stages, and infested by *Aphelinus fuscipennis*, both of which are also found in the Eastern States. These two insects breed through almost the entire year. The Aphelinus probably continues throughout the entire season, while the Chilocorus has probably only a very short resting period in midwinter and another perhaps somewhat longer in midsummer. The scale has quite a long period of rest, and does not begin breeding in spring until May. The result is that the predaceous and parasitic enemies have a distinct advantage over the scale and are able to keep it down to harmless numbers. None of the insects introduced from Australia which have been credited with controlling the scale ever had any effect upon it whatever. With the possible exception of *Rhizobius lophantæ* none of them were introduced into California until the scale in the southern part of the State had spent its force, and furthermore, *lophantæ*, the only species which has been found feeding upon the insects at all, does not become numerous until well along in the summer, and has besides no great partiality for orchards. It is found as frequently in the canyons as it is on cultivated lands. As to the predaceous insects introduced from Australia, their importance in California has been grossly exaggerated. Up to the present time they have not established themselves permanently in more than two counties in the State, and in regions where thousands and tens of thousands have been introduced they have died out almost completely. Very little of the evidence that is given as to the work done by these insects is reliable. Whenever any decrease of black scale is observed, and there is any *Rhizobius ventralis* about, this insect is credited with the work done. In a number of instances where trees were said to have been cleared by this insect, or rather the scale destroyed, it was found that while the scales were dead there was no sign of an injury such as would have been made by feeding upon it by either the larva or adult of *Rhizobius ventralis*. No reliable observations have been made, and a very large proportion of what is asserted is guesswork. *Rhizobius debilis*, about which so much has been published, and for which so much has been claimed, was not found in California at all, and there is every reason to believe that the insect has

died out entirely. In most cases the common Californian *Scymnus marginicollis* is mistaken for *Rhizobius debilis* and sometimes for *lophantæ* as well. *Rhizobius debilis* does not occur in any of the collections in California, except in imported specimens.

Rhizobius lophantæ was probably in California before it was sent in by Koebele, and must have been accidentally introduced quite a number of years ago. It was already among the mountains some miles north of Pomona in 1891, and was taken in some numbers in San Diego in 1892. It is an insect that is at least as abundant in the woods and on the shrubbery of the mountains as it is in cultivated orchards, and though specimens of it seem to be found almost everywhere, yet they never occur in any such numbers as to make the species a factor in keeping down scale insects. Aside from the *Vedalia* and *Novius*, which feed upon the Cottony Cushion scale, the species mentioned are the only ones that have been in any way established in the State. Perhaps *Orcus chalybeus* should be referred to here, because that is still to be found in small numbers in one orchard not far from Los Angeles. It has not increased, however, since the first year or two, and, on the contrary, seems rather to be dying out just as *O. australasiæ* did two years previously. Taking everything into consideration, there is nothing that warrants the assertions put forth by the horticulturists of California. There is no doubt that the native parasites of scale insects are very efficient in keeping down the insects to some extent; but of the 60 species imported by Koebele, in many thousands of specimens there is not one that can be considered a success at the present time. Of course there is a belief to the contrary, and some superficial evidence to sustain it; but there is at least as much evidence in the opposite direction, and it seems to me that the state of affairs hardly warrants the discontinuance of destructive measures against the injurious insects.

Mr. Howard said that the paper just read by Mr. Smith was one of the most important of the session, and that he was interested to know that Mr. Smith's observations corroborated Mr. Riley in his prophecy as to the futility of these later and miscellaneous importations. Even if Mr. Koebele has proved to be a poor prophet, however, no one will deny that he is an excellent collector and good observer, and at the time of his very favorable report of the condition of these importations, made at Mr. Riley's request (see Insect Life), the outlook was much more flattering than it now is, the situation having evidently in the meantime altered very materially. With reference to the explanation offered by Mr. Smith for the failure of these importations to become well established, viz, the unsuitability of the climate, he suspected that there might be another partial explanation in that Mr. Koebele had undoubtedly introduced an important parasite of the ladybirds (a species of Homalotylus), entirely inadvertently, and that the matter had been

apparently lost sight of, and he asked Mr. Smith if he had learned anything of this interesting phase of the matter.

Mr. Smith replied that he had heard nothing of this ladybird parasite. He stated also that *Rh. ventralis* is not easily established and dies out very readily, and is also preyed upon by Chrysopas. He thought Mr. Koebele in his report of conditions in 1893 had not given sufficient credit to the native twice-stabbed ladybird, everywhere present in abundance.

Mr. Howard, referring to the shipment of supposed introduced Australian ladybirds from California to Washington by Mr. Snow, collected and transmitted at the request of Mr. Smith, described the character of the material transmitted, which contained no Australian species whatever, but were all American species, no less than three of them being plant-feeders. After surveying the whole field, however, we can not but admit that one at least of Mr. Koebele's later importations has been of great benefit. That species is *Cryptolæmus montrouzieri*, which was imported into Hawaii for the purpose of ridding the coffee plantations of *Pulvinaria psidii*. The latest communications which he had received from Hawaii, both from the commissioner of agriculture and lands and from Mr. W. G. Wait, of Kailua, indicate that the expected work has been thoroughly accomplished. Through the kindness of Mr. Craw, specimens of this beneficial ladybird in the larval state have been received at the Department of Agriculture and have been placed upon orange trees affected by mealy bugs. The ladybird larvæ have taken hold energetically and are now in flourishing condition, while the mealy bugs are fast disappearing.

Mr. Smith gave an instance of the efficiency of this Cryptolæmus against mealy bugs, and stated that it is not adapted to out-of-door life in this country, but will accomplish good work in greenhouses.

In reply to a question from Mr. Fletcher, Mr. Smith said that he had not observed *ventralis* feeding on fungus, but he was firmly of the belief that it has this habit.

Mr. Hopkins presented a paper entitled "Insect Enemies of Forest Trees." The paper has been published in the Canadian Entomologist, Vol. XXVIII, No. 10, pp. 243–250, October, 1896, and in accordance with the policy adopted by the association can not be reprinted in its published proceedings.

In discussion Mr. Fletcher said that the subject covered by Mr. Hopkins is of great importance to Canada on account of the large lumbering interests there. He stated that the experience which Mr. Hopkins had described following forest fires is a common one in Canada. The two species most injurious in Canada under these conditions are *Monohammus scutellatus* Say and *M. confusor* Kirby. He gave an account of the habits of these species, mentioning, among other interesting points, the fact that they often go into the hard wood the first year, and that the larval

life, contrary to the old belief, is comparatively short, not exceeding one or two years, the very long periods sometimes recorded being undoubtedly accidental or abnormal. He said that in some of the forests north of the Ottawa River there are scarcely any trees that are not injured, and the yearly loss in Canada amounts to upward of a million dollars. He described the remedial treatment practiced in the Dominion, and particularly what is known as "rossing" of trees, which consists in cutting a strip of bark along the full length of the upper side of the log, causing the remaining bark to dry and eventually drop away. If they are protected by being immersed in water, it is necessary to turn them over in summer, otherwise the insects will work in the exposed side. After forests have been burned over, it is necessary to cut very promptly on account of the rapidity of the development and work of the beetles in question. He referred to the current belief among woodmen in explanation of the sudden appearance of these borers in burned timber to the effect that they develop from the souring of the sap.

Mr. Hopkins stated that this is also a common belief in West Virginia.

Mr. Fletcher further referred to the practical difficulties in getting wood cut at different seasons of the year. For instance, in early summer it is impossible to get cutters to go into the forests on account of the plague of mosquitoes and black flies at that season.

At the request of several members Mr. Fernald gave a résumé of the present status of the work of the gypsy moth committee, and his remarks were supplemented by Messrs. Forbush and Kirkland.

Mr. Fernald referred to the action of the association at its Springfield (1895) meeting, and stated that at the legislative hearings of the past spring, held with reference to determining the size of the appropriation to be granted for continuing the work of exterminating the gypsy moth, no representations made by the gypsy moth committee, the director, or himself carried a fraction of the weight that the indorsement of the association afforded. The legislators recognized the association as a body of eminent scientists and valued accordingly the opinion of its members.

In speaking of the present condition of affairs brought about by the failure of the legislature to provide sufficient funds for the continuance of the work in the most approved manner he stated that future action must be along one of three lines:

(1) To continue the work with a view to extermination. This can be done, but will involve a vast outlay.

(2) To attempt the control of the insect, but with no idea of the ultimate extermination. This means a great annual expenditure that must be continued indefinitely.

(3) To abandon the whole work, "let the insect spread at its own sweet will," and trust to the property owners to care for their own estates. Should this latter course be adopted, it would be impossible to say how long a period of time would elapse before the pest would spread over the whole of New England and into adjacent territory. The insect would soon be in a condition to spread fast through avenues of traffic, and its diffusion over the whole country would probably be a matter of comparatively short time.

The committee in charge and those directly connected with the work have been criticised because the importation of parasites has not been attempted. This, he explained, had not seemed wise while the work has been carried on with a view to extermination, since the latter condition involved the destruction of all large colonies wherever they occurred and would thus prevent the successful breeding of parasites. Such insects would require the most favorable conditions in order to become acclimatized, and this would necessitate the preservation of large colonies of the gypsy moth as food for the parasites. Should the work of extermination be abandoned, a careful study of the natural enemies of the gypsy moth in its native home would be advised. At the request of Mr. Fernald, Director E. H. Forbush presented a statement of the condition of the gypsy-moth work as it now exists.

Mr. Forbush first called attention to a common mistake in considering the work as that of the "gypsy moth commission," it being instead in charge of a special committee of the State board of agriculture. There was at the inception of the work a "commission" proper. This was removed by Governor Russell for malfeasance in office and a second commission appointed. This body served but a short time, the work being subsequently delegated to the State board of agriculture. To render the present status of the work more intelligible, Mr. Forbush gave a brief résumé of the history of the effort to exterminate the insect.

The work began under a grave misconception of the amount of territory infested. As soon as the State board assumed the direction of the undertaking it was found that the infested territory extended, not as believed by the first commission over a small and well-defined area, but instead over some thirty cities and towns. The size of the infested territory as considered by the first commission compared with the actual area later found to be infested was very aptly illustrated by a comparison of the size of a dollar with that of a broad-brimmed hat. In the fall of the second year of the work conducted by the State board Mr. Forbush and Mr. Fernald made a careful inspection of the infested region and prepared an estimate of the cost of extermination. Upon the convening of the legislature they asked for all the money that could be economically expended in one year, and no more. At that time the legislature lost the golden opportunity. Had sufficient funds been forthcoming to enable a vigorous prosecution of the work under the favorable conditions then existing the present condition as regards extermination would be much more satisfactory. But this was not all. The same legislative policy of reduced appropriations, granted after long and costly delays, has been followed year after year.

The work has suffered from two causes—apathy of friends and opposition of enemies. Friends of the work were apathetic except where their own property was damaged by the insect. Others opposed the work from personal reasons.

Mr. Smith inquired whether or not the infested territory had been reduced.

Mr. Forbush replied that the chief reduction had been made on the outside, but that many colonies had been also exterminated in the center of the region. The greatest progress was made during the first and second years of the State board work. There had been cases of reinfestation of "exterminated" territory from larvæ brought from the infested center.

At the request of Mr. Fernald, Mr. Kirkland spoke briefly of the experimental work of the past year. He stated that two main lines of investigation had been followed—experiments with insecticides and study of natural enemies. In conjunction with the chemist, who prepared the compounds, a large series of arsenical preparations had been tested. Sulpharsenates did not give results superior to arsenates. Experiments with arsenite of lead versus arsenate of lead had shown the two poisons to be about equal in insecticidal properties, the arsenite of lead not being quite as effective as the arsenate. The experiments with barium arsenate had already been described.

Of the hymenopterous parasites, *Pimpla pedalis* and *P. tenuicornis* had been reared in small numbers. The work on life histories of the predaceous beetles had been carried on by a man especially detailed for the purpose, Mr. A. F. Burgess, and much valuable information obtained.

The predaceous heteroptera had been studied by Mr. Kirkland and many doubtful points in their life history cleared up. These insects when emerging from their hibernating quarters attack the larvæ of the tent caterpillar in great numbers. Mr. Kirkland referred to the fact that the same legislative delay that hindered the spring field work also seriously handicapped the experimental work.

In discussing the above remarks, Mr. Hopkins highly commended the good work that had been done in destroying the gypsy moth, but expressed the opinion that extermination would not be accomplished, owing to the lack of financial support on the part of the legislature.

Mr. Lintner advocated the desirability of extermination and stated that it was his opinion that if the State would grant sufficient funds extermination would be accomplished. The time had come when Massachusetts should be aided by the financial support of the National Government. He contrasted the action of the Government concerning the Rocky Mountain locust invasions with its present inaction as regards the gypsy moth. National support would also inspire the Massachusetts people with more confidence.

Mr. Fletcher spoke in very flattering terms of the success in extermination thus far obtained and of the value of the special report on the gypsy moth to entomologists in general. This book he considered would be an invaluable reference work to economic entomologists. He had been in the infested region twice and knew that the work had been well done, and this in spite of difficulties arising from insufficient means.

In answer to a question by Mr. Fletcher, Mr. Forbush made a more explicit statement concerning the progress of the work and the

conditions governing the same. He cited the case of the city of Lynn, where over 1,000 colonies of the gypsy moth had been exterminated.

Mr. Fletcher suggested that the association should give formal expression of its opinion regarding the attempt being made by the State of Massachusetts to stamp out this pest.

Mr. Smith stated that New Jersey devoutly hoped that the insect would be kept within its present domain, and offered resolutions commending the work already accomplished by the State of Massachusetts and urging the continuance of the same with liberal financial support.

Mr. Webster moved the adoption of Mr. Smith's resolutions. The motion was seconded by Mr. Hopkins and was carried by a unanimous vote.

The resolutions are as follows:

Resolved, That in the opinion of this association the work done by the gypsy moth committee in Massachusetts is of the utmost importance and value, not only to that State, but to all the surrounding States and to the country at large.

Resolved, That in our opinion the cessation of the work of that committee would be a national misfortune, and a failure on the part of the State of Massachusetts to continue it would be a calamity which would involve immense loss to the people of that State and of the entire country.

Resolved, That we have full confidence in the ability of the officers now in charge of the work of this commission, as evidenced by the report recently issued, which contains not only matter of extreme importance to the economic entomologist, but of the highest value to the farmer and fruit grower.

The association then adjourned until 2 o'clock p. m.

AFTERNOON SESSION, AUGUST 22, 1896.

Mr. Slingerland exhibited and explained a series of mounted photographs illustrating some of the subjects which have been under investigation by the department of entomology of the Cornell Experiment Station during the year. The photographs were of insects, natural size and enlarged, and represented also the different stages, manner of work, and injuries to plants. Among other subjects, they covered the saw-fly currant-borer, army worm, pear midge, codling moth, etc. The photographs were exceptionally fine and strikingly emphasized the value of this means of illustrating insects and insect work. Mr. Slingerland gave a brief résumé of some of the more important facts relating to the subjects photographed, particularly the codling moth.

In the discussion which followed, Mr. Slingerland stated in response to a query from Mr. Smith, that the number of eggs deposited by a single female codling moth had not been determined.

With reference to the amount of arsenic which would be found in the calyx of a sprayed apple, referring to some of the analyses made by Mr. Slingerland, Mr. Smith said that we can hardly expect more than a trace of this small portion on a single apple when one considers the very small amount which goes on the entire tree. He believed that a very slight trace would be ample to cause death of the codling moth larva in its newly hatched state.

The excellence and value of the photographs exhibited were commented on in most flattering terms by Mr. Fernald and Mr. Lintner.

Mr. Hopkins also exhibited some photographs which were taken by placing the objects to be photographed on glass, which prevented the presence of shadows.

In the matter of the number of broods of the codling moth, Mr. Slingerland stated that as a general rule there is certainly but one brood in New York.

Mr. Fernald said that his experience indicated but a single brood for the codling moth in Maine.

Mr. Fletcher had found one brood to be the rule in Canada, except west of Toronto, where two broods are normal.

In response to a query by Mr. Smith, Mr. Slingerland described his method of preserving larvæ to keep the form and color. He said that it consisted in first dropping them in boiling water for about one minute, then placing them for permanent keeping in 50 per cent alcohol.

Mr. Smith said that he was following the same method, only varying in that he placed them for final preservation in a 2 per cent solution of formaline.

Mr. Lintner presented the following paper:

NOTES ON SOME OF THE INSECTS OF THE YEAR IN THE STATE OF NEW YORK.

By J. A. Lintner, *Albany, N. Y.*

The year has been characterized by the absence of attacks of the usual severity of a considerable number of our common insect pests, particularly those that infest our fruit trees. I do not recall a year before the present one in which reports have not been received by me of abundance of the apple-tree aphis (*Aphis mali* Linn.), and of injuries feared from it. The eye-spotted bud-moth (*Tmetocera ocellana* Schiff.), which has become so destructive to orchards in the western counties of the State, has hardly been heard from. No abundant presence of the apple-leaf Bucculatrix (*Bucculatrix pomifoliella* Clem.), has been reported; nor of the apple case-bearer (*Coleophora fletcherella* Fern.), until incidentally mentioned at the present meeting. The apple-tree tent-caterpillar (*Clisiocampa americana* Harr.), has been less injurious than in preceding years. The hop-vine aphis (*Phorodon humuli* Schr.), made its appearance late in the season, in August, in portions of Madison and Oneida counties, and the blackening of the leaves from deposit of honeydew excited some alarm, but it is not believed that serious harm has been done.

So far as my observation has extended, confirmed also by the observation of several collectors and others, with a few notable exceptions, the year has also been remarkable for a scarcity of insect life. Some short excursions made in the vicinity of Albany, specially for collecting,

were without any satisfactory results. My Adirondack collections were unusually limited. Apparently not one-fourth of the usual number of insects were abroad (exceptions to this were the common house fly and grasshoppers). Mosquitoes, the gray gnat (*Ceratopogon* sp.), and the black fly (*Simulium* spp.) were among the rarities even in the month of July. The scarcity of butterflies was particularly noticeable, and was remarked upon by others than entomologists. Not a single *Papilio turnus* was seen, nor any of the other Papilios except one *asterias*. No Graptas were taken, when in former years hundreds could have been captured. The argynnids were very few, and mainly *atlantis*. *Feniseca tarquinius*, for which Keene Valley is a noted locality, was not seen. *Colias philodice* was comparatively rare, while *Pieris rapæ* was abundant in the fields and about the blossoms of the burdock. The presence and capture of several examples of *Pieris oleracea* was welcomed as evidence that our once familiar native species had not been entirely driven away by the hosts of the foreign invader. In part compensation for the absence of so many of our diurnals, the beautiful "red admiral" (*Vanessa atalanta*) was uncommonly abundant in the last week of July and in early August.

The night-flying species—the moths—were also very few, and it was only possible to secure a few of the attractive Plusias that abound at these high elevations, but among them were several examples of the resplendent *Plusia balluca* Geyer.

In each of the other orders was there an equally poor representation of the species commonly met with—quite noticeable in the families of the Cicindelidæ, Coccinellidæ, Cerambycidæ, in the Bombyliidæ and Syrphidæ, in the dragon flies, and many others.

What particular climatic conditions have resulted in so marked a reduction in the usual abundance of insect life is beyond our knowledge. It would be interesting to know if any other class of the animal kingdom was similarly affected, and if it also extended to the flora.

The notable entomological event of the year has been the occurrence and the ravages of the army worm (*Leucania unipuncta*) over the greater part of the State from its eastern to its western borders and from its southern to nearly its northern boundary. It has been authentically reported from forty-eight of the sixty counties of the State. Its extension and the injuries committed by it are believed to be greater than had before been recorded in the State. When it appeared on Long Island and in Westchester County in 1880, although serious harm was done to the crops invaded, it was limited to the southeastern portion of the State, although spreading over some of the New England States, New Jersey, Pennsylvania, etc.

Its habits have been similar to the many recorded occurrences elsewhere, unless that in many instances its operations were first observed in rye fields. From these it spread to oats, to timothy, and corn. Clover has been reported as eaten by it, and pease to a limited extent. Grass, of course, was consumed in its travels.

Of its abundance it may suffice to state: In many places they occurred in millions. Roadways crossed by them were "blackened" by their numbers. They "covered fences," and it has been said that they covered sides of buildings. The noise made by their feeding could be heard after nightfall. The clothing of a person standing for a short time in an infested field needed frequent brushing and picking over to remove them. The sight of their marching armies was said to be "nauseating."

Of the many preventives employed heretofore to prevent their ravages, plowing furrows with a perpendicular side toward the field to be protected from invasion was the most effective, and the one more generally resorted to. Attempts to save fields of barley, oats, and timothy, when once infested, were of little avail.

The earliest notice of the insect within our State came to me on July 1, when they were found on corn near Albany. This was followed on the 2d instant by examples sent from Cambridge, Washington County, and for the week thereafter reports followed closely and thickly of army-worm ravages in several of the eastern counties, and later from southern and western parts of the State.

Larvæ received and collected by me were full grown and entered the ground for pupation as early as July 4. Two changed to pupæ on the 9th on the surface of the ground in the box with earth given them. On the 23d the moths commenced to emerge, and on the same date some of its parasites, *Nemoræa leucaniæ*, also made their appearance. Only a few of the parasites were disclosed. Their eggs had not been observed on any of the larvæ that I had examined, while in the western part of the State they have been reported as not at all uncommon.

The wheat-head army worm (*Leucania albilinea*) has been reported from the town of Morley, in St. Lawrence County. I was informed, under date of July 22, that the caterpillar, identified from examples sent me, was doing much damage in barley fields. Its operations were shown, first, in the awns of the barley having to a great extent fallen, or more probably been cut off, and second, a great number of the heads were cut off between the head and the next joint below. In one instance, where the crop had been a most promising one, it was estimated by the owner that two-thirds of it had been destroyed. The injury had not been sudden or rapid as in the work of the army worm, but had been under observation for some considerable time. The barley heads lying on the ground were subsequently eaten out, leaving only the husks or chaff remaining. This it was thought was done by the caterpillars.

A feature noticed in the work of this insect was that the leaves of the barley were not eaten—the first to be consumed by the army worm—but that, with the exception of the severed head, the plant was left in all its freshness and healthy appearance.

The spring canker worm (*Anisopteryx vernata* Peck), which is quite local in the State and seldom very injurious, has this season been committing serious depredations in scattered localities. The present year

Mr. E. J. Preston has sent, under date of May 21, samples of the caterpillars of various sizes, with some of nearly full growth. He represents them as skeletonizing the foliage in several of the orchards in his immediate neighborhood. Efforts had been made to stay their ravages through Paris green spraying. When used in several orchards by a person employed who was familiar with spraying methods, a mixture of 1 pound of the green and 4 pounds of lime to 200 gallons of water did not seem to kill a worm. The same in 150 gallons of water was also ineffectual. A third spraying with 100 gallons of water was next tried, the result of which had not been ascertained.

It would seem from the above, provided that the Paris green was of the standard purity, that the cankerworm is almost as resistant to the effects of Paris green as is the larva of the gypsy moth.

Mr. Preston refers to the observed habit of the caterpillar, which has been frequently noticed elsewhere, of dropping from the leaves when they have been nearly all consumed, and hanging by a thread until carried by the wind to some neighboring tree, or else dropping to the ground.

To the orchardists of Amenia the cankerworm is popularly known as the "fire worm," from the appearance of the leaves after all their green has been eaten away, as if they had been swept over by fire.

The insect has also been reported from several localities in western New York, the seasonal conditions having been favorable for its multiplication.

Cacœcia rosaceana Harr., known as "the oblique-banded leaf-roller," which feeds on an unusually large number of food plants, has been quite abundant and destructive in apple orchards. It has been sent to me from several localities in eastern and central New York as having been very injurious, not only to the foliage, but later in the season to the young fruit, into which it ate rounded holes of considerable size, often extending to beyond their center. Their injury had been quite serious in the orchard of Mr. Morris Tompkins, of Germantown, Columbia County. The moths were known to him from having reared them from the caterpillars, and on June 13 such numbers were drawn to light at night that apprehension was felt of the work of a second brood. Walsh and Riley have recorded as a habit of the caterpillar its gnawing off the rind of green apples, but I do not recall mention of its destroying the fruit by eating large holes into the interior.

Another caterpillar of larger size, of about an inch in length, of a pale-green color, and marked with white lines and dots, is also chargeable with eating into the fruit after the manner of the Cacœcia. I failed to rear the examples that were sent me, which I thought might be *Nolophana malana* Fitch. It has, I believe, been brought to the notice of Mr. Slingerland, and he has probably succeeded in rearing the moth from it.

The galls of a cecidomyiid larva on choke-cherry (*Prunus virginiana*) were brought by State Botanist Peck from Bethlehem, N. Y., May 28.

The larvæ emerged and entered the ground, but none of the flies have made their appearance.

In Keene Valley, in former years, I have found this cherry very abundantly galled by apparently the same insect in the month of July. Many larvæ were disclosed from them, but in the several attempts made to obtain the imago all have met with failure.

The present year not a single galled cherry could be found in the localities in Keene Valley where in other years they had abounded.

These galls have been studied by Prof. George F. Atkinson, of Cornell University, in connection with a fungus attack which he found to be usually associated with them, named and described by him as *Exoascus cecidomophilus* (see Bulletin 73, Cornell University Agricultural Experiment Station, September, 1894). It was not ascertained by him if the larvæ attack the fruit before or after the attack of the fungus. It was thought that the larvæ attack and deform fruits which are not affected by the fungus. In this he was probably correct, as I have no recollection of the fungus presence on the galls collected by me in Keene Valley.

This cecidomyiid has not as yet been described, although it has been observed by several entomologists.

The larvæ of *Euphoria inda* Linn., formerly known as the Indian Cetonian, were found in large numbers beneath chip manure at Menands, N. Y., in the latter part of June. From their general appearance and from their occurrence in manure they were believed to be the "muck-worm" (*Ligyrus relictus* Say). Examples were brought to me within the manure inclosed in a box. Not long thereafter they were found to have eaten all of the excremental portion, leaving only the bits and pieces of chips and a large quantity of rounded pellets of their excrementa. These, together with additional ones obtained, were transferred on July 30 to a larger box, with an ample supply of food. The box was opened from time to time until the 8th of August, when two *Euphoria inda* were resting on the surface. Examination of the contents gave the following: Two perfect beetles within their cells, one of which was on the point of emerging. Another cell gave a beetle, uncolored, having just transformed from the pupa. The remaining cells (5) contained pupæ.

Do the larvæ feed also on growing vegetation? State Botanist Peck, from whom the larvæ were obtained, had applied some of the manure to a few hills of corn in his garden. The following day one of the hills was noticed as having been cut down as if by cutworms. Upon digging around the stalks two larvæ of the Euphoria were discovered, but no cutworms, from which it would seem probable that the grubs had committed the injury.

The oak pruner (*Elaphidion villosum* Fabr.) is not, I believe, of frequent occurrence on apple trees, but during the first week of June its operations were very noticeable in an orchard in Voorheesville, Albany County, where a large number of twigs and branches had been thrown

to the ground by it. Some of the branches brought to me were from three-tenths to seven-tenths of an inch in diameter. Each contained the mature and active larvæ within a closed cell in its burrow prepared for pupation. *E. parallelum* Newm. (regarded by many as identical with the preceding species) was very abundant in early June in the maples bordering the avenues in the grounds of Governor Morton, Ellerslie, in Dutchess County. Not a maple was seen which had not a score or two of the recently fallen pruned branches lying beneath it, although previous gatherings had been made and destroyed.

The asparagus beetle (*Crioceris asparagi* Linn.) is continuing its spread in the central and western counties of the State. In my ninth report reference is made of its appearance at Geneva, Ontario County, in the year 1884, and at Rochester, Monroe County, in 1892. June 2 of the present year (1896) Mr. A. P. Case, of Vernon, Oneida County, sent to me asparagus twigs bearing numerous eggs of the beetle and shoots eaten by the larvæ. He writes:

> The insect has appeared since May 30 on all of the asparagus beds here, where they have never before been seen. Every sprout is covered with the worms, and the new seedling shoots are alive with the full-grown worms, and newly hatched ones are burrowing into the stalks. The tops of the eatable shoots are alive with the mature worms, which eat them off as they appear. The crop is worthless for this year.

To-day a further extension of the insect within our State has been brought to my notice in examples given me by Mr. Ottomar Reinecke, of Buffalo, N. Y., which were collected by him the present week from wild asparagus growing in the outskirts of the city.

The ash-gray blister-beetle (*Macrobasis unicolor* Kirby) was received June 9 from New York City, where it was reported as feeding destructively on a locust hedge. The young and tender leaves at the end of the branches had been eaten over the entire extent of the hedge of about 600 feet in length. They were driven away or killed when the pyrethrum powder recommended for them was applied. Examples of the same insect came June 25 from Factoryville, N. Y., where they were rapidly destroying the leafage of potato vines.

Chinch bug.—A correspondent from Almond, Allegany County, writes that the insect is very thick on his new seeding and has ruined his pastures, and that it has destroyed his meadows for the past four or five years. They were working in the greater part of his 300 or 400 acres of land. Mr. E. P. Van Duzee in his collections in Erie and Niagara counties the present year has met with only a few scattered individuals of the species.

The San Jose scale (*Aspidiotus perniciosus* Comst.) has apparently found the climatic conditions unsuited to its establishment in all except the extreme southeastern part of our State. Its existence in a few localities has been reported to me, but in each instance another scale has been mistaken for it. At the Kinderhook locality, where it was first discovered in the Hudson River valley, it has been nearly exterminated.

Recently its presence was suspected by the owner of the orchard, Mr. Morrell, where it had been found abundantly two years ago, but on examination the scale proved to be a rather closely resembling one, *Aspidiotus juglans-regiæ* Comst. An examination of the orchard showed no living San Jose scales, but later a single living specimen on a twig was brought to my office by Mr. Morrell.

A neighboring orchard in Kinderhook was reported as badly infested with the scale. On examination in July by Mr. E. P. Felt, my assistant, the scale was found in abundance on plum trees of apparently ten or twelve years' growth, but upon perhaps twenty trees that were carefully examined not a single living scale was found. The trees had not been treated for the scale, and it is therefore probable that the insect had been winterkilled. How long they had been upon the trees or the source of the infestation was not learned, but the age of the trees would indicate that the pest had not been introduced on nursery stock. The orchard was within one-fourth of a mile of that of Mr. Morrell, and it is highly probable that it had been carried from there by birds or insects.

The scale was also reported in August from another locality in New York—in the valley of the Wallkill River, a tributary of the Hudson River. A few fruit trees in an orchard in Middletown, Orange County, were stated to be infested with the scale, the trees having been received from a New Jersey nursery. Inquiry was promptly made of the owner of the orchard of the extent of the infestation, with proffer of assistance if needed, but no reply having been received, it is probable that the infested trees were promptly destroyed and that the spread of the insect was not feared.

The peculiar oak kermes (*Kermes galliformis* Riley), which bears so marked a resemblance to a gall as to be mistaken for it by everyone not acquainted with it, may not be rare when one knows where to look for it, but it has always been a rarity in my own experience. One of my correspondents, Mr. W. R. Walton, of Middletown, N. Y., has been fortunate in his collection of it, and has kindly contributed a number of examples to the State collection. He also has been successful in breeding from it the beautiful lepidopterous parasite, *Euclemensia bassettella* Clem., with which it is so frequently infested and of which he has made excellent colored drawings in its several stages. From kermes taken from scrub oak in the latter part of December he obtained the moth toward the last of the following June. The larger number of the mature kermes were found to be infested by the parasite.

Gossyparia ulmi Geoff., a European coccid feeding on most of the varieties of the European and American elms, was first noticed in this country at Rye, Westchester County, N. Y., in June, 1884. (See Howard in Insect Life, Vol. II, pp. 34–41.) Examples of it were brought to me from Marlboro, Ulster County, in July, 1888. Since that time it appears to have become distributed in different portions of the State,

and to have planted itself in several localities in the vicinity of Albany. In May and again in June it was brought to me from Loudenville, Albany County, and in June of the same year from two places in the city of Albany, and also from Catskill, Greene County, 40 miles to the southward.

In June of the present year Mr. J. B. Washburn brought a limb of elm from his grounds at Delmar, Albany County, bearing dense patches of the scale. It was blackened to a degree that indicated the abundant presence of the scale the preceding year. The tree, a young one of about 3 inches diameter of trunk, was infested both upon the trunk and the limbs. Other elms upon his grounds were not infested. The scales were apparently about full grown, but no young had yet been given out.

A large number of trees in the city of Albany are at the present time (August) showing severe and injurious attack from this insect. The leaves are blackened by their secretions and some of the branches whitened by their abundant presence. Their larvæ, about half grown, are to be seen in large numbers in the crotches of the smaller twigs, on the lower surface of the leaves, and in crevices of the bark. The infested trees are mainly the Scotch elm (*Ulmus montana*).

The insect is also quite generally distributed in Troy, 6 miles to the north of Albany, where, in combination with the attack of the elm leaf-beetle, it is threatening destruction to many of the trees. It also occurs at Menands and Watervliet, between Albany and Troy.

Referring to the experience given by Mr. Lintner relating to the inefficiency of arsenicals against the spring cankerworm, Mr. Fernald stated that he was much surprised at this, as he had always had good success with Paris green at the rate of 1 pound to 150 gallons. He questioned if the Paris green used by Mr. Lintner were not of an inferior quality.

Mr. Lintner said this last supposition might be correct.

Mr. Fernald also asked if the author of the paper had data on which he could make a prediction of the probable behavior of the army worm next year.

Mr. Lintner thought that the army worm would probably not be a notable insect next year.

In response to a query by Mr. Fletcher, Mr. Lintner stated that an instance of severe invasions in two consecutive years by this insect was not known, so far as he remembered.

Mr. Hopkins thought that he remembered an instance of a two years' invasion.

Mr. Webster stated from his experience with the cankerworm that Paris green will kill the young larvæ readily, but is ineffective with the half or two-thirds grown individuals.

Mr. Lintner stated that the specimens experimented with by him were at least two-thirds grown.

Mr. Webster stated further that the bud worm, to which Mr. Lintner referred, had been also quite troublesome and abundant in Ohio, and also that *Euphoria inda* had been a serious pest to the peach crop the present season, eating into the ripening fruit.

Mr. Howard, referring to the oak kermes, stated that it was at one time particularly abundant at Ithaca, N. Y., and its lepidopterous parasite was also equally abundant.

Mr. Kellicott stated that the scale was very common at Columbus, Ohio, but the parasite referred to was not present.

Mr. Kirkland stated that the damage from the army worm in Massachusetts the present year would amount to upward of $250,000, being chiefly to the cranberry crop. In the case of this crop some relief was gained by cutting over the districts, and as the fields dried up the worms abandoned them. He had had an early experience with the army worm, in which he advised rolling over the ground with a heavy roller, a recommendation which frequently appears in early writings upon this insect.

Mr. Howard, referring to the discussion of the army worm, stated that it was obvious that in different localities the present season two or more distinct generations of the worms had formed the injurious armies. He stated that in Virginia he had known the second generation to be an injurious one in one season, and in another season certainly the third and probably the fourth. Apropos to Mr. Kirkland's experience with the use of rollers, he said that his first experience with the army worm occurred in the early summer of 1879 on reclaimed Dismal Swamp lands near Portsmouth, Va. He there advised, not from practical experience, but from consulting Harris and Fitch, the use of a roller, and one of the farmers afterwards told him that if there could have been a layer of asphalt pavement between the worms and the roller he firmly believed that the worms would have been crushed! As it was, however, the use of the roller was inefficacious. In this particular case the outbreak was controlled by isolating the infested sections by flooding the draining ditches, the isolated patches being then burned over.

Mr. Smith stated that the army worm had also been present to some extent in New Jersey, but was limited to particular fields, and the total loss from this insect in the State was not large. The damage did not occur at the same time in different parts of the State. In Monmouth County the injury was by the first brood in May. Northward the injury was by the second brood in July. Referring to the common asparagus beetle (*Crioceris asparagi*), he said a portion of every brood goes into hibernation. The other asparagus beetle (*Crioceris 12-punctata*) is spreading over the entire State. Referring to the work of Elaphidion, he stated that they had never been so numerous in New Jersey as the present year, and were especially liable to occur in branches injured by the cicada. The elm pest, *Gossyparia ulmi*, had been brought to his attention, he stated, for the first time this year, occurring on a tree in a private garden, and had been completely exterminated by the owner.

Mr. Johnson said the early brood of the army worm had been very destructive in Illinois in the vicinity of the experiment station. A very important contagious disease affecting army-worm larvæ had been discovered by a former assistant of Mr. Forbes, Mr. B. M. Duggar, and this disease had been worked up most carefully by Mr. Forbes. The facts regarding it would probably soon be published. He described the appearance of the diseased worms.

Mr. Johnson read the following paper:

ENTOMOLOGICAL NOTES FROM MARYLAND.

By W. G. Johnson, *College Station, Md.*

The Maryland Agricultural College has this season established a department of entomology and will offer regular courses of instruction, beginning with the coming scholastic year. The new department is united under one management with the State agricultural experiment station.

Another step of considerable importance was the passage of an act by the last general assembly of Maryland known as the "trees and nursery stock" law. It provides for the appointment of a State entomologist, whose duty it shall be to inspect all nurseries in the State each year with a view of detecting the presence of the San Jose scale, yellows, rosette, or any other injurious insect or plant disease. The owner is notified of the presence of any insect pest or disease that may be found on his place, and the proper remedies for its destruction are suggested. If he does not take such steps in the time specified for the suppression of the pest, he lays himself liable to a fine of $1 for every tree, plant, or vine so affected when shipped from his nursery. In such a case the entomologist can enter the nursery, employ such assistance as he needs, and apply the proper remedies for the destruction of the pest at the expense of the owner.

Every nurseryman or seller of trees within the State is required to send on every package so shipped or delivered, as well as to transmit to the purchaser by mail, a written or printed certificate signed by him that the stock has been examined by the State or Government entomologist and that it is free from insect pests and plant diseases. Failure to furnish such certificate renders him liable to a fine of $100 for every such shipment or delivery without such certificate.

If the stock is found free from insect pests and plant diseases, the entomologist furnishes the owner with a certificate to that effect and files a similar certificate with the governor of the State and with the president of the Maryland Agricultural College, which certificate must at all times be subject to public inspection.

The section of this law that provides for a certificate which is to be affixed on each package of trees, plants, vines, or nursery stock shipped

into the State of Maryland from any other State, showing that the contents have been inspected by a State or Government officer and are free from insect pests and plant diseases, is perhaps of greater interest to entomologists and nurserymen outside the State of Maryland than any other section. Upon satisfactory proof that the provisions of this act have been violated the packages must be returned to the shipper or consignor, unless the agent or consignee shall have the stock examined by the Maryland State official, who will furnish the necessary certificate in case no injurious insect or plant disease are found. In consequence of a failure to return the stock to the shipper or to have it examined by the State entomologist it must be burned and destroyed.

From the fact that the San Jose scale has been found in several nurseries in Maryland, I realize that it is practically impossible for even an expert entomologist to be certain that the pest has been entirely exterminated from such nurseries and furnish the owners an absolute guaranty of freedom from scale. As pointed out by Dr. Howard and Mr. Marlatt in their excellent bulletin on the San Jose scale (Bulletin No. 3, New Series, p. 71), "no examination can be so thorough as to make it impossible that not an individual scale has been overlooked, and the wide range of food plants makes it always possible for the scale to be reintroduced from near-by sources." I believe, with the authors of this bulletin, that the only safe course is to demand from the nurseryman, secured by State legislation if necessary, a written certificate that the stock has never been infested or subject to infestation, that it has been examined by the State or Government entomologist, and, further, that he will assume the responsibility for the subsequent damage should his belief in the cleanliness of the stock prove ill founded. With such legislation, strict quarantine laws rigidly enforced, and the destruction of local sources of infestation, I believe the San Jose scale can be kept in check in any locality. Extermination is another thing. When the attack is confined to comparatively small trees and over a limited area, I believe the pest can be completely destroyed, but when established in large fruiting orchards its complete destruction means an expense in apparatus, material, and labor far beyond the means of the average horticulturist. In conversation with one of the largest and most successful fruit growers in Maryland recently he told me he would give $1,500 cash if his orchards were free from the San Jose scale. He is a man of exceptional ability and push and proposes to leave nothing undone to suppress the scale. Last year he spent nearly $400 fighting it, using over 400 gallons of whale-oil soap, applying it at the rate of 2½ pounds to a gallon of water; but the pest is still present on his trees and openly challenges the intelligence and enterprise of this thoroughgoing horticulturist for its suppression. Although discouraged, he still has hope, and will repeat the same heroic treatment with soap this fall and winter.

The most alarming part of the situation in Maryland is the fact that

there are several large orchards in certain localities where the scale has a firm foothold, and the owners are doing nothing to destroy it. It is consequently spreading to other orchards in the vicinity, and one becomes a source of infestation for another. Steps are now being taken to destroy, if possible, these local centers where the pest exists.

Next to the San Jose scale the melon plant louse (*Aphis gossypii* Glover) has caused more damage in our State than any other insect this season. Hundreds of acres of canteloupes were destroyed by it in Baltimore, Anne Arundel, Prince George, Charles, Calvert, St. Marys, Wicomico, and Dorchester counties the latter part of June and early in July. Many winged individuals were abundant July 20, and in many instances the lice thickly covered both sides of the leaves. Underspraying with kerosene emulsion diluted with twenty parts of water was the most convenient method of treatment where a large number of vines were infested.

The asparagus beetle (*Crioceris asparagi*) has been exceedingly abundant and destructive over a large part of the State this season. I saw large numbers of larvæ on asparagus near Chestertown, in Kent County, August 11. The 12-spotted species (*C. 12-punctata*) is also becoming quite common. I have collected it in Prince George, St. Marys, and Kent counties this month.

The potato-stalk weevil (*Trichobaris trinotata*) has done considerable mischief to potatoes in Baltimore and Harford counties. August 10 I visited a 6-acre potato field in the vicinity of Greenwood, in Baltimore County, and found nine-tenths of the vines had been killed by this insect. Nearly every stem contained one or more larvæ or pupæ. Potatoes all over the State have also suffered great damage from the attacks of the Colorado potato beetle (*Doryphora 10-lineata*) and the blister beetle, *Epicauta cinerea*.

To cabbage, the cabbage worm (*Pieris rapæ*) and the harlequin cabbage bug (*Murgantia histrionica*) have been particularly destructive over the entire State. The latter, however, has been by far the greater pest.

The strawberry weevil (*Anthonomus signatus*) appeared in great abundance early this season and was very injurious to certain varieties. Mr. R. A. Miller, director of the experiment station, tells me that on the station grounds and in Montgomery County the "Sharpless" and other staminates were more severely injured than the pistillates, especially the "Crescents."

The peach has suffered greatly from the attacks of the plum curculio (*Conotrachelus nenuphar*). Much of the fruit has ripened prematurely and fallen from the trees. The codling moth (*Carpocopsa pomonella*), aside from doing much damage to apples, has this season been very common in pears.

August 17 I found the fruit bark-beetle (*Scolytus rugulosus*) at work on plum trees in an orchard in Prince George County. The adults were busily at work perforating the trees.

The imported elm leaf-beetle (*Galerucella luteola*) has been very abundant on the English elm this season. Four large trees on the experiment station grounds were almost completely defoliated. The larvæ came down the trunk in great numbers, but many climbed the trees again. This upward movement was checked by bands of dendrolene painted around the trees about 3 feet from the ground. The substance did not seem to interfere with those that were coming down, as they usually tumbled over it and buried themselves in the kainit which had been scattered, at Prof. H. J. Patterson's suggestion, around the base of the trees, where they died by the myriads.

The locust leaf-beetle (*Odontota dorsalis*) has this season almost completely defoliated the locusts of southern Maryland. The attack has been very general along the Potomac River as far north as lower Prince George County. It has been found much farther north, but not in such great numbers.

The paper was briefly discussed by two or three members.

Mr. Smith stated that the potato stalk-borer, which was so very threatening in New Jersey two years ago, had caused no damage since.

Mr. Webster presented the following paper:

INSECTS OF THE YEAR IN OHIO.

By F. M. Webster, *Wooster, Ohio.*

The outbreak of the year in this State was that of the chinch bug, discussed in a separate paper, and perhaps the next in importance was that of the army worm (*Leucania unipuncta* Haw.). Though widespread, the occurrence of this pest could hardly have been termed general, and the injury caused was largely local. It is not often that both this species and *Blissus leucopterus* occur together, but this season has seen both destructively abundant over the same area and at about the same time. To the peculiar meteorological conditions explained in my paper on the last-named species may, I think, be attributed the causes for this unusual phenomenon. Many of the worms received were parasitized, and a bacterial disease also prevailed.

The cankerworm, *Anisopteryx vernata* Peck, occurred locally about as the preceding species, and in some cases worked considerable injury. I am at a loss to account for the contrary reports that have come to me in regard to the inefficiency of spraying with Paris green in destroying this pest. It must be that as the worms get older they are less susceptible to the effects of this poison, as reports of failures come too often and from those who are too careful and reliable to admit of such experiences being ignored.

Considerable injury was done to grain and meadows in May and June throughout some portions of the State by a grasshopper, *Melanoplus bivittatus*. In Wyandot County especially, the timothy and clover

meadows suffered very severely over quite a tract of country. The "hopper-dozer" or sheet-iron pan was used to advantage in destroying them, but the locust mite (*Trombidium locustarum*) was much more efficient, though its effect came too late to protect the crop.

The harlequin cabbage bug (*Murgantia histrionica*) continues to increase in numbers and severity of attack along the southern border of the State, where it was first observed three or four years ago. I can not understand why it should push northward so much more rapidly in the interior than along the coast, if its progress is being carefully noted in the east. It has been reported with specimens fully 30 miles north of the Ohio River, and at that rate of progress will reach the latitude of Columbus and Philadelphia the coming year,* whereas in New Jersey it has pushed northward very slowly. In Ohio it is spreading to the north at the rate of about 25 miles per year. Through the assistance of Prof. H. A. Morgan, entomologist of the Louisiana Experiment Station, an experiment is being made in introducing egg parasites of this pest, and one lot received from Professor Morgan has been liberated near Portsmouth, on the Ohio River. Whether we shall succeed in colonizing these parasites and whether or not they will withstand our northern winters are problems yet to be solved, but we hope for the best.

The bag worm (*Thyridopteryx ephemeræformis*) is reported by the superintendent of parks of Cincinnati as giving unusual trouble this season, notwithstanding that it has been fought industriously, and as I thought, successfully, during the last two years. This pest has long been known in southwestern Ohio, as far north as Dayton, but it was only within the last two years that Dr. Kellicott and myself have been able to locate it as far north as latitude 40°. Last winter I received what appeared to be the abandoned sack of a male from Grand Rapids, Ohio, within 25 miles of Toledo, on Lake Erie. As I have since received specimens from points intervening between this and Dayton, and have in no case been able to trace its introduction to trees or plants brought from more southern points, it would appear that the species has established itself locally throughout almost the entire latitude of western Ohio.

The asparagus beetle (*Crioceris asparagi*) is pushing its way westward across northern Ohio, having proven quite destructive this season 10 to 15 miles west of Cleveland. On the other hand, I find that it is only making its first appearance along the extreme northeastern border of the State, about Ashtabula, Andover, and Youngstown. Strangely enough, I have invariably found it in a locality first on isolated plants escaped from cultivation.

* In the discussion following this paper Dr. D. S. Kellicott, of Columbus, reported its appearance at Licking Reservoir, a little north of Columbus and to the eastward, while on my arrival home I learned that specimens had been sent to the station from Paint Valley, Holmes County, only about 20 miles south of Wooster, which is in latitude 40° 48′.

In May there were strong indications of serious trouble from cutworms, but later a large black worm, the larva of *Calosoma calidum*, appeared in such numbers as to attract the attention of farmers all over the State. From the reports received, and the number of specimens sent me by farmers in widely separated localities, I infer that there was a general increase in numbers of this dusky friend of the farmer, and that it was largely due to their presence that we escaped an invasion of cutworms.

Over the southern portion of Brown, Clermont, and Hamilton counties the black locust (*Robinia pseudacacia*) was more or less defoliated by the locust leaf-miner (*Odontota dorsalis*) and the same was true of the adjacent portion of Kentucky. The trouble appeared to begin some 15 miles back from the Ohio River, in Ohio at least, and increased in severity toward the south. July 10, I found nothing but adults, but these were so abundant that I could easily beat half a gill into an inverted umbrella from a single branch.

Saperda candida, which I have never found anywhere except rarely, was sent me this year accused of gnawing into young apples, the fruit inclosed with the specimen giving ample evidence of its fondness for this sort of fare; besides, it was captured in the very act of attacking apples in the orchard.

Disonycha triangularis caused considerable injury to the foliage of beets and mangel-wurzels by riddling the leaves with holes.

Mr. R. H. Warder, superintendent of city parks for Cincinnati, reported injury to geraniums by white ants (*Termes flavipes*), bringing me specimens of the living plants with the insects burrowing in the stems.

Valgus canaliculatus worked serious injury in April in southern Ohio by eating out the fruit buds of pear and other fruits, and in case of young apple trees it destroyed the leaf buds.

A minute capsid, *Halticus bractatus* (kindly determined for me by Prof. H. Osborn), was detected in injuring the leaves of red clover by sucking the juices from the upper surface of the leaves, causing these leaves to turn to a whitish color. The young also feed in the same way, but the discoloring of the leaves appears to protect them, as the affected leaves harmonize more nearly in color with that of the young. The adult female simulates to a marked degree a small saltatorial beetle, *Chætocnema parcepunctata* Cr., which also feeds upon clover, while the male capsid has the normal form. My assistant, Mr. C. W. Mally, found the Halticus on cucumber near Cleveland, and informs me that it also occurs in Iowa. As this species so closely resemble beetles that affect our crops, and as farmers to whom I have pointed out the capsid have, without a single exception, called them flea-beetles, though the two feed in an entirely different manner, it would seem quite possible that some of the reported failures to kill the beetles with poisons might be due to mistaking one of these insects for the other.

An undetermined species of Myzocallis, as determined by Mr. Pergande on request of Mr. Howard, was excessively abundant in timothy meadows in southern Ohio in June, appearing to have damaged the hay crop over quite a large area fully 20 per cent, and in one meadow near Portsmouth the damage was fully 50 per cent. I was unable to reach the infested meadows until nearly all of the depredators had disappeared, which they did very suddenly, but I found nearly all of the leaves of timothy had become brown and nearly worthless for fodder. The few specimens found by me were on the upper side of the leaves near the base, but very careful observers in whom I have perfect confidence say that there were a week earlier, or about July 1, hundreds of them on many of the blades of timothy, and that these last turned yellow and then brown. In the insectary, where we have the species under continual observation, we have found these statements to prove true.

The grape root-worm (*Fidia viticida*) still ravages the vineyards along Lake Erie, east of Cleveland, but I am pleased to say that the ravages seem to be on the decline. I can see no other reason for this except the increase in numbers of enemies to the eggs. The minute egg parasite, *Brachystichta fidiæ* Ashmead, has increased enormously within the last two years, and I also found the mite, *Heteropus ventricosus*, present this season for the first time and in situations that leave no doubt that it will prove a powerful ally in reducing the number of Fidia larvæ entering the ground this season. So far we have found bisulphide of carbon too expensive, while kerosene emulsion can not be applied to the vines because of spotting the grapes, and its application to the roots to destroy the larvæ in the ground is wholly impractical, even if effective, which has yet to be proven. The adults do not yield at all readily to poison and we have had poor success with driving the beetles away with applications of Bordeaux mixture containing 9 pounds of copper sulphate and 6 pounds of lime to 50 gallons of water, notwithstanding some encouraging reports from several growers.

The San Jose scale (*Aspidiotus perniciosus*) is not spreading in Ohio, so far as I can learn, but is being exterminated wherever it has been introduced and such introduction become known. In two orchards near New Richmond, Ohio, kerosene in an undiluted form has been used with marked success, both last year and this, without the least injury to the trees, either apple or peach. I am unwilling to recommend this treatment for general use as yet, but the results gained as against the San Jose scale are so valuable that I give the details, with the hope that equally good results may be obtained elsewhere during other years. Where the top was seriously infested with scale this was cut away and burned, the trunk painted with kerosene, and at the proper season grafts were placed in the stubs of the old limbs that had been left sufficiently long for the purpose. In this case a new top has been grown on the old trunk, often a more symmetrical top than the original, the tree thereby losing but little by reason of the attack by

the scale. Last July I went through the orchard and found many of the trees thus treated growing nicely and free from scale. A less successful experiment was to cut away the trunk a couple of feet above the ground, paint with kerosene, and later graft on this stump, the idea being to secure a new trunk as well as top. But in this case the grafts grew so rank that they were twisted off by the winds, and the result for this reason was not satisfactory. Where trees were known to be slightly infested, or as a means of killing the scale on any trees not known to be infested, an entire orchard, consisting of both apple trees and peach trees, was sprayed with undiluted kerosene during February, and in order to make sure that no scale escaped alive a second application was made shortly after. I saw the orchard in April and again in July, and in neither case did I notice any injury whatever to the trees, either apple or peach. Different conditions might alter results, but in this case I have to report a complete success during two successive years in the same locality.*

Mr. Fernald stated as a fact worthy of record the finding by himself of an adult specimen of the apple-tree borer girdling a shrub on Dog Mountain, Desert Island, at an elevation of 1,000 feet. No apple orchards occurred within a mile of this point.

Mr. Slingerland stated in regard to the codling moth that he had found an average of one egg in four parasitized by *Trichogramma pretiosa*.

Mr. Fletcher exhibited some apples which he had lately received from British Columbia, containing the larva of a tortricid which works in the fruit very much as the apple Trypeta. This is a new enemy, and in the district from which the fruit came is already a very serious pest. The species is not known, and, it is supposed, may prove undescribed.

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*These statements brought out so much discussion, interspersed with criticism, that I decided to write the owner of one of these orchards and get from him an up-to-date statement in regard to both the applications and results. I herewith append a reply to my request for such information. I have no additions or qualifications to make to the letter of reply by Mr. Nichols, in whom I have perfect confidence:

NEW RICHMOND, OHIO, *September 11, 1896*.

F. M. WEBSTER.

DEAR SIR: Yours of the 8th instant came to hand yesterday. Contents noted, and in reply I wish to say that the kerosene (clear coal oil such as we use in our lamps) which we used was applied principally in the month of February when the ground was frozen. We applied it with a small varnish brush to some small trees to the entire tree, on others only the limbs that were the most affected.

My brother used a barrel sprayer, applying 40 gallons of pure coal oil on 500 apple and 15 peach trees. A part of the orchard he sprayed the second time. The applications were made, respectively, on the 17th and 24th days of last February—cold and frozen.

Trees that we used the clear coal oil on two years ago, as well as those last winter, have made splendid growth and the entire lot of trees look as though they had been rubbed smooth and varnished.

Kerosene and a sprayer is the remedy for the San Jose scale.

Yours, truly, D. H. NICHOLS.

Dr. Kellicott gave some further notes on the distribution and more recent increase in the range of the harlequin cabbage bug in Ohio. He also referred to a bagworm which seems to be distinct from the common species and probably undescribed.

Mr. Smith referred to the use of pure kerosene on trees in Ohio, and asked whether the Department of Agriculture had conducted any direct experiments showing the effect of the use of this oil undiluted.

Mr. Marlatt stated that during 1879 some of the elm trees on the grounds of the Department were surrounded with a band of cotton saturated with oil, which resulted in the death of the trees. The later experience with the use of kerosene oil was in the work against the San Jose scale. At Riverside, Md., the owner of a large peach orchard in his attempt to use kerosene emulsion had made an unstable product, and was, when visited, found to be applying practically pure kerosene to the trunk and larger branches. The results of this application were disastrous, but the trees in question were already much weakened by the attacks of the scale. Later in the winter Mr. Marlatt said he had personally, to test the effect of the oil, sprayed some healthy and vigorous peach trees, uninjured, or practically so, by scale, making the application thoroughly to all parts of the tree with an ordinary spray pump. These trees were killed outright, not surviving the winter. He was firmly of the opinion that an application of kerosene oil to trees, except perhaps where limited to light applications to trunk and lower branches, would result most disastrously, and urged Mr. Webster to make personal tests before recommending this dangerous application.

Mr. Hopkins presented the following paper:

SOME NOTES ON OBSERVATIONS IN WEST VIRGINIA ON FARM, GARDEN, AND FRUIT INSECTS.

By A. D. Hopkins, *Morgantown, W. Va.*

The principal inquiries with reference to insect pests of the farm, garden, and orchard within the last year have been about scale insects.

An article that was sent to the State and county papers warning farmers and fruit growers of the dangerous character of the San Jose scale, and the possibility that it might be already established in their orchards brought letters of inquiry and specimens in great numbers to the experiment station, so that a pretty good opportunity was had to ascertain the distribution of the San Jose scale as well as of other scale insects.

So far but five localities have been found in the State in which the San Jose scale occurs, namely, Wellsburg, Brooke County; Martinsburg, Berkeley County; Georgetown and Morgantown, Monongalia County, and Charleston, Kanawha County. So far as I can learn, the scale has not spread from the infested orchards, and in those I have personally examined had not, so far as I could find, spread from the

trees on which they were introduced, although they had been in the orchard since the spring of 1894. All of the trees that the scale was found on came from a New Jersey nursery, but it was certain varieties of trees only that were infested, the Idaho pear being the principal and almost only one infested, while in some instances hundreds of trees purchased at the same time and of the same nursery were found, after a careful search, to be perfectly healthy and free from the scale.

My instruction in each case where I have been consulted has been to grub up and burn every infested tree, and so far as I can learn this has been done.

There are doubtless other localities in the State, however, where the scale occurs, but where it has not been recognized, so that every effort will be made to find other localities and to prevent the spread of the pest in the State.

The scurfy bark-louse (*Chionaspis furfurus*).—It would appear that this scale is quite common and widely distributed in this State, since it has been sent in from many different sections. The oyster shell bark louse is also common and quite destructive in some sections, principally within the range of the transition zone.

The *rose scale*, the *plum scale*, and other insects, and even twigs the bark of which was covered with prominent lenticels, were sent in by persons who thought they might be the dreaded San Jose scale.

Cutworms (not the Hopkins variety of newspaper fame, but those having normal transformation and feeding habits) were exceedingly common and destructive in our State in the spring and early summer of 1895, but, as was predicted, they gave comparatively little trouble the past spring. This scarcity of the pest this year is due, I think, largely to the abundance last year of an Apanteles parasite that emerged from the cutworms in enormous numbers. So abundant were the conspicuous yellow or white bunches of the cocoons on grass and grain stubble and on weeds and grass in pasture fields near Morgantown and other localities visited last summer that in places I could count hundreds of them within a radius of a few yards.

The webworms (crambids).—These insects attracted general attention for the first time last year, and were serious pests in cornfields and gardens.

The harlequin cabbage bug has proven to be a serious pest in certain sections of the State within the past few years. It was quite destructive to cabbage in the experiment station garden last year, but scarcely a single example has been observed this year until quite recently. Whether or not this early absence of the bug is due to the late fall and winter plowing of the garden I can not say, but it would appear that such may be the fact.

Blister beetles as enemies of China asters.—Last summer a fine bed of assorted and rare China asters growing in the experiment station flower garden was literally ruined by the black blister beetle (*Epicauta pennsylvanica*) within a day or two after the flowers began to open. It

was therefore determined to find some method of protecting the blooms this year, so I recommended covering them with mosquito netting stretched over a temporary frame. This was done, and proved quite successful until all the flowers had opened and some were beginning to fade, by which time the beetles (which occurred on the netting in great numbers all the time the asters were in bloom) learned that they could get in by eating holes in the netting, and they soon availed themselves of this method of entrance and feasted on the flowers. The holes would probably not have been eaten in the netting had not some of the flowers pressed against it, thus allowing the beetles to feed through the covering. A higher frame covered with netting which had been previously dipped in oil would have proven successful.

A chalcidid enemy of clover seed.—June 13 of the present year (1896) I observed a great many examples of what I first supposed to be a Eurytoma parasite in and on a paper bag in which some ripened heads of crimson clover had been stored. Upon close examination to find their host insect I was thoroughly surprised to find that it was not a parasite of an insect, but that it bred in the seed, and that scarcely a seed could be found in the bag that had not been a host of one of the interesting little creatures. Specimens of the insect were sent to Mr. William H. Ashmead for determination, who kindly identified them for me as *Bruchophagus* (*Eurytoma*) *funebris* How. By reference to the literature on the habits of the species I found that it had previously been bred from clover seed and was generally recognized as a parasite of the clover-seed midge (*Cecidomyia leguminicola*), and that it was believed to be especially beneficial in diminishing the ravages of the midge.

This information led me to make a careful examination of a large number of infested seeds, but as yet I have failed to find any evidence whatever that it is a parasite of the midge or any other insect, but, on the contrary, quite conclusive evidence was found that it is a parasite of the seed. It would also appear from what I have observed that it is far more destructive to the growing red and crimson clover-seed crop than is the midge.

Larvæ of the clover-seed midge were observed in some of the clover heads examined, but since the Cecidomyia larvæ prevent the development of the seed, while the chalcidid larvæ develop within the seed which attains normal size, the two species can no longer be associated as host and parasite.

Bumblebees and red clover.—In a recent study of varieties of timothy and red clover I deemed it necessary to make some further investigations with reference to the pollenization of the clover flower and the relation of insects to the crossing of varieties, and it would appear from the results obtained that the value of bumblebees to the grower of clover seed has been somewhat overestimated, since I have found that honeybees and other smaller bees may and do serve the same purpose in pollinating or cross-fertilizing the red-clover flower as do the large bumblebees.

Mr. Webster, referring to the subject of the setting of clover seed, said that in his experience a good crop of seed always followed an attack of the clover leaf-weevil, and, therefore, the latter insect is often actually a means of putting money into the pockets of the farmers.

Mr. Howard read a paper entitled "Remarks on steam spraying machines," which will appear in full in the Yearbook of the Department of Agriculture for 1896.

Some discussion followed on the subject of nozzles, the experience of different members with various nozzles being given. The "cyclone" nozzle was objected to by some on the ground of its lack of sufficient carrying power. The McGowan nozzle had not always given good satisfaction. The Nixon nozzle was also mentioned. The general opinion seemed to be that the "cyclone" nozzle was the best for all ordinary purposes, supplemented with the Nixon and McGowan for spraying larger trees.

Mr. Webster stated that inquiries were beginning to come in from farmers and orchardists for a steam-spraying apparatus and that he was convinced that as soon as a practical machine was put on the market it would be in great demand.

Mr. Fernald said that the botanist of the Massachusetts Station, at Amherst, had been using some sort of steam-spraying apparatus and regarded it as a success.

Mr. Howard stated that a very satisfactory apparatus could now be had for about $300, which was considerably less than first estimates.

All of the papers the authors of which were present having been read, and the hour being late, on motion of Mr. Howard, it was ordered that the balance of the papers in the hands of the secretary be read by title and left to the executive committee to determine whether or not they should be included in the published report of the proceedings. The committee deemed all the papers in question worthy of publication, and they are here included.

NOTES ON NEW AND OLD SCALE INSECTS.

By W. G. Johnson, *College Park, Md.*

In December, 1894, I discovered a scale insect on cherry trees at Champaign, Ill., which, on account of the nature of its attack, I consider a very important economic species. After a careful study of a large amount of material and much correspondence with Dr. L. O. Howard and Prof. T. D. A. Cockerell, I believe the species is new to science and have described it as *Aspidiotus forbesi* and have given it the popular name of the cherry scale. The description of this species, together with four others mentioned below, will appear in an illustrated article soon to be published in the Bulletin of the Illinois State Laboratory of Natural History, Vol. IV, Art. XIII.

I consider the cherry scale the most dangerous scale insect now established in Illinois. It has a variety of food plants, but wild and cultivated cherry seem to be its favorite. I have found it also on apple, pear, plum, quince, currant, and possibly honey locust and mountain ash. It attacks the trunk and branches and is occasionally found on the leaves and fruit. In June of the present year I found several immature scales on cherries. July 6, 1895, I collected several currants on which scales of this species were found, and August 14, 1895, I gathered apples from the Illinois Experiment Station farm containing scales of fully matured females.

It hibernates as a partially matured insect and is double brooded in the latitude of Springfield, Ill. The mature males begin to appear about the middle of April and the first brood makes its appearance early in May. It is not an uncommon thing, however, to find young and eggs as late as June 20. The mature males of the second brood begin to appear about July 10 and continue to emerge until about the first of August. I am of the opinion that there are three broods in extreme southern Illinois. It is related to Putnam's *Aspidiotus ancylus*, but may be readily distinguished from that species by the second pair of lobes of the last segment of the female, the number of spinnerets and other characters presented by the adult male, and the scales of both sexes.

This pest, however, is by no means free from the attacks of natural enemies. I have reared from it seven species of hymenopterous parasites, determined for me by Dr. L. O. Howard, as follows: *Prospalta murtfeldti* How., *Prospalta aurantii* How., *Perrisopterus pulchellus* How., *Signiphora nigrita* Howard MS., *Arrhenophagus chionaspidis* Aur., *Ablerus clisiocampæ* Ashm., and a species belonging to the genus Encyrtus. The twice-stabbed ladybird (*Chilocorus bivulnerus*) and its larva are very important factors in the reduction of this scale insect. I have very often found a small whitish mite under scales containing dead male pupæ. Whether the pupa had been killed by the mites or whether they had been attracted there by the presence of the dead insect I have not been able to determine as yet.

In spite of its natural enemies it has a firm foothold in Illinois, and can be kept in check only by the most energetic and persistent fighting. It is not an uncommon thing to find 7 and 8 year old cherry trees in that State literally covered with this destructive scale. It is also present in certain nurseries in Illinois, as I know from personal inspection. It is of great consequence, therefore, to all those interested in fruit culture to be on the lookout for this ravenous pest.

I wish to call your attention to three other species of Aspidiotus recently described by myself. Only one of these, however, is of much consequence from the economic standpoint. I have proposed to call it *Aspidiotus comstocki* in honor of my teacher and friend, Prof. J. H. Comstock, of Cornell University. It has been very abundant for several years on sugar maple (*Acer saccharinum*) in Illinois, at Mount Carmel,

Decatur, and Champaign. I found it also on maple in Ohio, at Columbus, the early part of July, this season, and have had it from Mr. R. H. Pettit, who collected it on maple in Ithaca, N. Y., two years ago. It attacks the leaves, living in great numbers on the under side, causing yellowish spots on the upper surface. The spots are minute at first, but become more prominent as the insect develops and the season advances, causing the leaves to fall prematurely. The partially-matured insects spend the winter under the leaf buds. I have found it only on maple, and as it attacks the leaves principally I have proposed the popular name of the maple leaf scale, to distinguish it from other allied species. It is related to the grape scale (*Aspidiotus uvæ* Comst.), but may be readily separated from that species by its yellowish-gray or whitish scale and the structural characters of the male and female.

Of the other two species I found *Aspidiotus ulmi* on the trunk of white elm (*Ulmus americana*) at Urbana, Ill., about a year ago in rather limited numbers, and so far as my observations go it does not attack the branches, twigs, or leaves. I found the other species, *Aspidiotus æsculi*, on buckeye (*Æsculus californica*), at Stanford University, Cal., three years ago. It attacks the trunk, branches, and smaller twigs, but so far as I have observed does not occur on the foliage. The color of the scale usually conforms to that of the bark, and when not abundant the insect is difficult to detect.

In February, 1895, the markets of central Illinois were stocked with California oranges of a very inferior grade. The local dealers at Champaign sold them for russet oranges. The russetness, however, was due to a complete covering of the red scale, *Aspidiotus aurantii* Mask. The consumer paid 40 cents a dozen for this tasteless fruit.

August 8, 1895, Mr. G. W. McCluer, of the Illinois Experiment Station, handed me a lot of apple grafts from A. Woodroffe, Auckland, New Zealand, for examination. I found *Aspidiotus camelliæ* Bois., the greedy scale of Comstock (= *A. rapax*), upon five of the seven varieties represented. The scales were attached usually under the buds. The females were fully matured and an occasional young louse was found on the twigs. This scale is widely distributed in this country, and, according to Maskell, is common throughout all the North Island of New Zealand, and in parts of the South, on euonymus, apple, plum, and other trees.

Early in August a year ago I found Putnam's *Aspidiotus ancylus* on English oak (*Quercus robur*) in Urbana, Ill. The attack was confined to the under side of a few of the lower branches. This season the insect has spread to all the larger and smaller branches, and many of the lower branches have died, being literally covered with this insect.

Aspidiotus nerii was very abundant on certain plants in the greenhouse at the University of Illinois early this season. It was particularly destructive to the so-called lace fern (*Asparagus plumosa*).

The English-walnut scale (*Aspidiotus juglans-regiæ*) is very common on the white or silver maple (*Acer dasycarpum*) in Illinois. I have also

found it on the same food plant in Ohio. The grape scale, *Aspidiotus uvæ*, is very often found in Illinois, but is not a serious pest so far as I know.

The oyster-shell bark-louse (*Mytilaspis pomorum*) is common throughout Illinois, and is, in my opinion, the cause of far greater injury to apple trees in that State than has been attributed to it. I believe it is double-brooded as far north as Springfield, Ill. The eggs of the first brood hatch early in May at Champaign, and I believe a second brood appears in August. I found this scale on rose (Baltimore belle) at Relay Station, Maryland, this season, from which I bred the adult male insects August 8.

The scurfy bark-louse (*Chionaspis furfurus*) is also very injurious to apples in Illinois. I have shown by a series of experiments, conducted a year ago, that this species is two-brooded. At Champaign the young of the first brood appear about the 1st of May, and the female begins to deposit eggs for the second brood usually the first week in July. The young of this brood begin to appear about July 10, and the adult males are abundant usually from the 10th to the middle of August.

I have found several other species of Chionaspis on shade trees in Illinois, but will mention only three of them in this place. The willow scale (*Chionaspis salicis*) is very common on willow. The pine scale (*Chionaspis pinifoliæ*) is also very destructive. Several large and beautiful pines on the campus of the University of Illinois have been killed this season, and two were dug up and burned last year. The scale is double-brooded in that region, the first brood appearing usually the first week in May and the second the first week in July. Another species of this genus, which I have described as *Chionaspis americana*, is found on white elm (*Ulmus americana*) throughout Illinois. Mr. R. H. Pettit has also sent me the same species on elm from Minnesota. It is very destructive to elms planted for shade and ornamental purposes. I have also found it upon virgin timber, and believe that it is a native American insect. The female scale is yellowish brown at first, but becomes lighter, nearly white, with age and exposure. The male scale is pure white, and characteristic of the genus. The eggs are purplish. There are two broods, the first appearing about the 1st of May and the second early in July. The male is peculiar in that there are two forms—one with well-developed wings and the other with mere stubs. The attack is confined to the trunk, branches, and twigs. The male scales often cluster on the underside of the leaves; an occasional one, however, may be found on the upper surface.

The rose scale (*Diaspis rosæ*) has been very destructive to raspberry and blackberry in Illinois for several years. It is also common on rose. The peach lecanium (*Lecanium persicæ*) was reported to me by the Prairie Farmer from one locality in Madison County, Ill. The attack was confined to a single tree, which was cleared by close pruning and a thorough washing with soap. I bred an adult male of this species from material from this tree April 24, 1895.

Last season I found a Lecanium very abundant on white elm in Illinois, and worked out its life history through the first brood this spring. I have not determined it specifically.

NOTES ON THE ENTOMOLOGICAL EVENTS OF 1896 IN IOWA.

By Herbert Osborn, *Ames, Iowa.*

It is not my intention in this brief note to attempt a review of the insect peculiarities of the season, but merely to call attention to some of the striking events of the season up to the present time.

The army worm (*Leucania unipuncta*) has perhaps occasioned more general attention and apprehension than any other species, and there has undoubtedly been no small amount of actual damage as a result of its abundance.

It was first reported in May from the southeastern part of the State, and from the fact that it was four or five weeks earlier than the time of its usual occurrence in the State I was inclined to believe that one of the common species of cutworms was responsible for the reports, especially as such cutworms had been received from other localities.

The receipt of undoubted army worms, however, set all question at rest, and within a few days specimens and reports from many localities proved a general invasion. The numbers were certainly greater than have come under my observation before, and can only have been equaled by an outbreak some thirty years ago, which, according to reports of early settlers, was quite destructive, but which from the fact that only a small part of the State was settled was of more restricted injury.

A second brood appeared in July and, like the first, caused quite general apprehension, especially where oat fields were destroyed and corn threatened.

With this brood, however, there was a very general appearance of parasites, especially of *Microgaster militaris*, and so extensive have been the operations of the latter that I do not anticipate further serious destruction.

The chinch bug has demanded attention through a considerable area, embracing particularly several southeastern counties that have been similarly affected during the two preceding seasons. Injuries, however, have been less, I surmise, than last year. The season has been much more favorable to the spread of disease among them, and either from a natural spread or as a result of artificial introductions has been, so far as reports will justify a judgment, much more effective. While showing the possibilities of this method under favorable conditions it only emphasizes the necessity of such conditions and strengthens my belief that it would be unwise to encourage farmers to rely upon this means as their sole dependence in control of the chinch-bug pest. We have this season been sending infection material with instructions to

scatter at once in the field where bugs are most abundant, using the infection box only in case of extreme dryness or where additional material is desired.

A quite unusual attack has occurred upon potatoes by a species of leaf hopper which, so far as I am aware, has never been destructive to this crop in this locality. It first appeared upon early potatoes in the fore part of July and in many fields caused an almost total loss of the crop. Late potatoes suffered less either because of the changed conditions of weather or the movement of the insect to some other crop. The insect agrees in every particular with the *Empoa albipicta* as described by Forbes, but I believe this species is really an Empoasca and to be referred to the *mali* of Le Baron. That it may live quite as freely on potato as other plants is shown by the fact that larvæ developed there. An experiment with kerosene emulsion showed that by using four nozzles and a strip of board to drag the tops of the vines, so as to expose the under surface of the leaves and also to cause the insect to fly into the air, a large proportion could be destroyed. In this way it is believed we greatly benefited the field experimented upon.

Scale insects have naturally received considerable notice on account of the apprehension that the San Jose scale may at any time appear within our borders. Thus far there has been no appearance of this pest in the State, though I have on many occasions examined specimens that were supposed to be of this species. The most interesting of the species that has come under my notice in this connection is the *Aspidiotus rosæ*, which caused quite serious destruction to roses and some other garden plants in Muscatine. The species has not been observed in the State hitherto, but seems to have become quite a serious pest in that locality.

The hickory bark-beetle (*Scolytus 4-spinosus*) has caused considerable damage in some localities and attracted attention particularly by the destruction of foliage, due to the cutting of the adults into the petioles of the leaves.

While this injury attracts much more immediate attention than the work of the larvæ in the bark, there can be no question but that where it occurs there is a certainty of the further injury which the larvæ will occasion by their operations.

The Hessian fly (*Cecidomyia destructor*) has made its appearance in the State, and so far as I am aware this is the first season that it has been recognized or in which it has occasioned noticeable losses. If it has been present hitherto it has been in such limited numbers as not to attract attention, or at least not to be reported to the station. Its principal center of injury at present appears to be in Buena Vista County, which is in the northwest part of the State and one of the spring-wheat counties.

A point which is of interest as well as of particular significance to the wheat growers is that its parasites seem to have occurred with it

in full force, as among the specimens sent me all have produced the *Semiotellus destructor* instead of imago Cecidomyia. Usually it is believed that the parasites are somewhat behind the host in occupying any new territory, but here they seem to have followed with them in their first introduction or to have so nearly kept pace with them as to warrant the hope that they may prevent any great devastation.

The elm span-worm (*Eugonia subsignaria*) was unusually destructive in one of the southeastern counties (Washington), a correspondent in that locality reporting that the larvæ had defoliated "acres and acres" of timber land. This is, I think, the first serious invasion of this insect ever reported in the State.

The cucumber aphis, the potato stalk-weevil, the squash borer, and some other species have been locally destructive, but on the whole probably not more serious than usual. In many different species there has been a sufficient variation from normal abundance to show the influence of peculiar climatic conditions.

IS COOPERATION FOR THE CONTROL OF SAN JOSE SCALE PRACTICABLE?

By Wm. B. Alwood, *Blacksburg, Va.*

When I undertook to collect data on this subject I fully expected to be present at the meeting and present my matter in person. Circumstances have, however, prevented my attending, and I will only offer a few notes covering in part the subject I had intended to discuss. I hope, however, that what is said will lead to discussion and action by the members of our association.

Messrs. Howard and Marlatt have so thoroughly treated the general subject of the San Jose scale that it is unnecessary for me to say anything whatever covering the details of the life history and like critical data concerning this insect.

Early in the present year I began collecting data relating specifically to several practical points, viz: (1) The spread of this insect in the several Eastern States infested; (2) the thoroughness and manner of inspection; (3) the extent to which nurseries are infested and the probable facts as to whether this insect will become a permanent habitant and continue its destructive work throughout the extent of the Atlantic States. Also the question of legal enactments for the control or eradication of this insect and the extent to which cooperation seems advisable was made a part of the inquiry.

Such information as I have obtained has come largely from the station entomologists and other public officials in the colleges or the various State boards of agriculture.

After making as thorough an inquiry as I could well do through the persons who ought to be informed on this matter, I find that, unfortunately, there are not sufficient data for determining with any accuracy

the spread of this insect in the several States infested. In only one instance, and that the small State of Delaware, did I find that there has been a systematic inspection of the State, and New Jersey has doubtless been much better inspected than any of the States of considerable size in the East. So it would appear that our present knowledge of the infested areas in the several States has come largely through reports of its injurious occurrence either in nurseries or orchards and not from critical inspection. This suggests, in the first place, that we are even yet, after all the literature that has appeared upon this subject, quite in the dark as to the probable damage which agriculture may suffer in the near future from this pest. We, in fact, are not yet in position to speak at all of its probable or possible occurrence in a large number of isolated places over the Eastern States where it has not yet been reported as injurious.

To illustrate how easily a whole neighborhood may be infested without having come to the knowledge of entomologists, I may cite a few instances which have come under my observation. One of these was in the lower valley of Virginia, near Winchester, one of the best cultivated and most prosperous sections of the State, where a considerable orchard had become infested and some of the trees were already dead, yet this infection was not known and had not been reported at all until by mere chance a party interested observed the infested trees and sent specimens to me for determination. Another instance which well illustrates this point is that of the Salem district in the upper valley of Virginia. This place is less than 40 miles from the Virginia Agricultural and Mechanical College and the center of a very intelligent community, surrounded by highly cultivated farms and agriculturally one of our most prosperous sections, yet the scale had existed there for four or five years and been disseminated quite generally over the immediate locality by the tree dealers. During all this time the fact of this infection was totally unknown, though I had constantly received from this place numerous specimens of other injurious insects and fungi affecting fruit plants; and to enforce this point more strongly I will relate an incident connected with the occurrence of this scale at Salem, Va. A few days prior to my official inspection there certain parties, observing that many fruit trees were infested with scale insects, sent specimens to Congressman P. J. Otey of that district, and he submitted them to Mr. Howard, who in due course pronounced them to be *Aspidiotus ancylus*. Yet my inspection revealed the presence of the pernicious scale in great abundance. In fact it was by far the most common injurious species in the community, yet by a strange chance a common native species was sent to Washington, and these people were congratulating themselves on being free from San Jose scale.

Less than two days' work in this community revealed to me the presence of the San Jose scale in very serious numbers at ten different points in and about Salem, and I doubt not that double and treble this number of premises are actually infested.

Other like instances illustrating the probable fact that this scale is much more widely disseminated over the Eastern States than we have any knowledge of might be given, but these two will suffice to illustrate the point that we first need systematic inspection before we shall be able to form any comprehensive idea of the task we have before us in suppressing this pernicious insect.

We have the barest general idea as to the nurseries which are infested outside of the State of New Jersey and Long Island, New York, where doubtless Professor Smith and Mr. Sirrine have done the best work in the way of inspection of nurseries that has been done in the East.

My experience in Virginia leads me to believe that there are a large number of small nurseries, especially those which have dealt largely in rehandling New Jersey and Maryland grown stock, scattered all over the Atlantic States which are more or less infested and are acting as distributing centers for this insect.

Only six of the Eastern States are reported to me as having infested nurseries, and in none of these does it appear that any thorough system has been adopted, or at least executed, for the proper control of nursery stock to prevent the dissemination of this scale.

Only four of the fourteen Eastern and Middle States now reported as infested have any legislation which at all relates to the control of this pest, and in these States, so far as I am aware, but little has been done to make the law effective. Back of this lies the real and strong question as to whether these laws can, under the present aspect of the question, be made effective.

To speak definitely of my own State, I may say that we have a law which gives us ample power to inspect all premises, whether nurseries or fruit plantations, and to take drastic measures to secure the destruction of infested stock, or its treatment where such is deemed advisable; but the general public knows that no similar measures are being executed with any thoroughness throughout the Eastern States, and are very much inclined to oppose the execution of any law and to cover up the fact of the existence of the scale.

Prior to the passage of our law I had for three years done all I could to ascertain infested localities and gain information concerning the insect, but practically little came of my efforts. Only one point of serious infection, that at City Point, was discovered by me during this time, and this came about through no direct effort of mine. In fact, it was simply an incident in the ordinary course of my correspondence which led me to detect it.

Shortly after the Virginia law was passed empowering us to deal with this question I issued a pamphlet of general information and began a much more thorough investigation of this subject. Prior to this time we felt quite convinced that there were only two districts in the State seriously infested, but in a very few weeks after we began serious work the scale was located in three new districts and the extent of the premises infested in each was found to be far beyond our

expectation. In fact, we were at once convinced that the execution of our law, as drawn, would be impossible, and that any attempt to isolate and eradicate the scale from the numerous premises which were found to be infested would involve an outlay of time and money much greater than our station could possibly undertake.

To speak plainly, our investigations thus far have shown that this insect has gained such a wide dissemination in the State that no action which a single official could possibly take would have much effect in eradicating it, and we have come to believe that the proper duty of the experiment stations or of such State authorities as attempt to control this insect is not to put forth further personal effort to control the scale wherever it may be found in individual localities, but to strike deeper and to at once put the nurseries under such a system of surveillance that its further dissemination from them will be checked with certainty.

However, the work of clearing the fruit plantations already infested must not be neglected, but its accomplishment must rest largely with the individual growers in the several communities interested.

A State officer can very properly, and with great profit to the locality interested, supervise and direct the general work; but unless the individual growers will actually engage in executing the orders or directions which may be given them there is no hope that the insect can be checked.

If I am right in believing that the first duty of the official entomologist is to check the dissemination of this pest through the nurseries; then the question of the cooperation of the several States is a prime point, and must be made the basis of all effective work. Certainly all will agree that it is quite useless for the nurseries of one State to be inspected and subjected to drastic control if nurseries just across the border in another State can with impunity ship infested stock into the neighboring State. This it appears is exactly the present status of the case, and hence nurserymen in those States which have laws providing for inspection and eradication of the scale properly enough feel that they will be subjected to great annoyance and probable pecuniary loss by the execution of any drastic law when their competitors in a State where such laws are not enforced are permitted to enter their State and sell stock free of all control. It is a delicate and important question to say how far or in just what lines cooperation is practicable or shall be undertaken.

The legislation of the several States is so at variance, even in the laws already passed, and methods of executing laws within the several States also are so at variance, that a serious question arises whether any real security will be attainable by legislation of this sort.

Every person, and especially every entomologist, who has had anything to do with the execution of special enactments of this nature knows that the people resent and very often rebel against what they consider improper interference with their private affairs.

It is very well to say that the people must be educated, but it is another matter to accomplish this fact, and in the meantime we are in the presence of a real and serious danger.

Every person to whom I have written on this subject, except one, believes in cooperation among the several States, but few indeed are clear as to what lines or under what general plan we could undertake cooperation.

For my part, I am of the opinion that any cooperation that may be undertaken should deal solely with the nursery question, as the question of local infection is a matter for the individual States to deal with.

Whether we could secure the enactment of a general law in all the infested States is to me a question of very grave doubt; in fact, I feel almost certain that it would be impossible to secure a law under which the several entomologists could act in unison. Consequently I am led to suggest that if there can be some scheme devised by which we can secure thorough and critical inspection of all nurseries and full publication of the facts we may be able to accomplish the desired result much more speedily and with vastly less cost than to wait for special legal enactments by the several States. But this step if undertaken would need to be surrounded with proper safeguards. This inspection would become a matter of such critical importance that every possible care would need to be observed to make it absolutely fair and impartial. And then the publication of such data could not, in justice to the commercial interests of the several States, be left to the individual stations, colleges, or boards of agriculture, but should be made a conjoint affair and only issued after the most painstaking efforts to verify every observation reported. In fact, it seems to me that here is an instance in which the Department of Agriculture at Washington, acting as a central authority, should take up the work and publish such a report as I have indicated above. If a thorough inspection could once be completed it would thereafter be quite a simple matter to keep tab on the nurserymen and publish from time to time a blacklist of such as refuse to follow out proper regulations to insure the character of the stock disseminated by them.

The foregoing thoughts cover in a general manner the problem as it presents itself from my brief experience in Virginia. I hope the association will give me the benefit of their best suggestions, and if any worker has really faced this matter and found out how we are to suppress this dangerous pest without cooperation, so far as relates to its dissemination on nursery stock, I will be delighted to learn the facts.

At the meeting of the American Association of Agricultural Colleges and Experiment Stations next November in Washington, I hope to be present and read a paper on my experience in attempting to suppress this insect in Virginia. I wish this association here present might take some action looking toward carrying this question of cooperation before that meeting by report of a committee or otherwise, as may be deemed best.

THE DEVELOPMENT OF THE MEDITERRANEAN FLOUR MOTH.

By F. H. Chittenden, *Washington, D. C.*

In the article on insects injurious to stored grain prepared by the writer for the Yearbook of the United States Department of Agriculture for 1894, the following statement was made on page 285 concerning the development of the Mediterranean flour moth (*Ephestia kuehniella* Zell.): "From experiments conducted during the year at Washington it is estimated that under the most favorable conditions, i. e., in the warmest weather, the life cycle consumes about five weeks." This estimate was given in comparison with the record of M. J. Danysz who conducted observations on the development of this species in France. M. Danysz gives on page 11 of his memoir on this moth* a brief statement showing that from moths that issued under his observation from the 15th to the 20th of August a second generation of moths developed from the 13th to the 18th of October. He concludes with the statement: "Thus we have obtained a complete evolution in about two months, from the 15th of August to the 15th of October."

My estimate of five weeks is quoted by Mr. W. G. Johnson in his excellent article on this species recently published as an appendix to the Nineteenth Report of the State Entomologist of Illinois (p. 28) in contrast to experiments conducted by that writer "during midsummer, under the most favorable conditions in California and Illinois," whereby he was unable to obtain a full-grown larva in less than five weeks from its emergence from the egg, his shortest period from the deposition of the egg to the issuance of the adult being placed at fifty-nine and one-half days.

This experiment, according to Mr. Johnson's table on page 29, was, I judge, conducted at Champaign, Ill., from April 29 to June 28, 1895.

My estimate has gone on record without the details to substantiate it, the limited space allotted me for my Yearbook article having been insufficient for the purpose.

With a view to the ascertainment of the exact truth, a series of experiments was undertaken the present year as soon as the weather promised anything favorable in the way of obtaining minimum developmental periods.

In my experiments to determine the life history of insects affecting stored products a special effort has been made to determine the minimum period of each stage. The reasons are these: With but few exceptions, indoor insects are of tropical origin and attain their highest development and are consequently most troublesome in warm climates. Again, with scarcely an exception, the different species cause, by their ravages in cereals and other products, a certain amount of decomposi-

*Mémoires du Laboratoire de Parasitologie végétale de la Bourse de Commerce, Vol. I, 1893.

tion, which induces a high degree of temperature, often of 90° and over, in cold weather many degrees higher than in the surrounding atmosphere. Under certain conditions this temperature may be maintained the year round, and it is therefore necessary to know the minimum periods before we can determine or even estimate the number of generations that may be developed in a year.

The following account of my experiments is given:

PERIOD FROM EGG TO ADULT.

Experiment No. 1.—Newly hatched larvæ from eggs deposited April 18 were placed in corn meal. June 2 one had transformed to pupa, the moth issuing June 9. Two more moths appeared the day following, a total of fifty-two days as the life cycle for this period, which happened to be cooler than normal for this latitude.

Experiment No. 2.—Moths placed in corn meal April 30 produced the first members of another brood June 14, or in forty-six days. Weather normal.

Experiment No. 3.—Adults confined with corn meal at midday, June 10, 1896, and four moths of the new brood were found to have issued July 20. The exact date of issuance was not ascertained owing to the writer's absence from the office Sunday, but from their appearance they had bred either during the night of July 18 or 19, and the duration of the period was between thirty-eight and thirty-nine days. The temperature for this period, although not unseasonably cool, was not as warm as in previous years, the indoor temperature not ranging above 82° F. except on three or four days.

Experiment No. 4.—Moths placed in corn meal June 22. Two full-grown larvæ left the meal July 20 to seek a place for transformation, and the following day about 20 followed suit. Three moths issued during the night of July 30, being found early on the morning of the 31st, and giving nearly the same period from the egg to moth as in the preceding experiment, thirty-eight days.

INCUBATION.

An experiment to determine the minimum period of incubation began on the afternoon of April 18, when a few moths were placed singly in vials for the purpose. These were examined at 6.30 p. m. and at 11 p. m. and a large batch of eggs found to have been laid in one of the vials in the interim. A considerable proportion were found to have hatched early in the afternoon of April 23, or about four and one-half days from the time of deposition. Weather the first day very hot, the second quite cool, the remaining time seasonable, the indoor temperature ranging from 91° to 66° F.

In colder weather the egg state may last as long as two weeks. In Mr. Johnson's experience it lasted from seven to nine and one-half days, the eggs having been deposited in April, August, and October.

THE PUPAL PERIOD.

An individual that pupated July 29 at 4 p. m. transformed to adult at about the same hour August 6, just eight days later. A second that transformed to pupa at the same time did not issue till 1 p. m. the following day. A third example found to have pupated early on the morning of July 28 did not issue as a moth till 3.15 p. m. of August 7. These three rearings alone show that there may be considerable individual variation in even so small a matter. The two pupæ were kept side by side and under precisely the same conditions.

The temperature was exceedingly hot, the thermometer ranging from 85° to 92° F.

Other experiments at different temperatures gave from nine to twenty seven days as the period of the pupa state, as follows:

Pupa formed.	Moth issued.	Period.	Temperature average.
July 25	Aug. 3	9 days	83°
May 30	June 9	10 days	Seasonable.
August 29	Sept. 8	10 days	80° to 84°
April 29	May 15	15 days	Seasonable.
March 1	Mar. 28	27 days	Cool.

THE LARVAL PERIOD.

The duration of the larval period is more difficult of observation than is that of the egg or the pupa. Time, labor, and patience may be saved by simply calculating it by subtracting the egg and pupal periods from the entire cycle periods.

This would give us, by estimate from experiments Nos. 4 and 5 (thirty-eight and thirty-nine days), a larval period of twenty-four or twenty-five days as a known minimum.

Mr. Johnson's article on the flour moth is the most complete work yet published on any species of insect affecting stored grain. His results are beyond question, and although he has refrained from unfavorable comment, in self-defense I must pass criticism.

Admitting a difference in atmospheric conditions between the District of Columbia and central Illinois, where Mr. Johnson's shortest period was obtained, it should not be more than a week, as affecting the entire life cycle of an insect. Again, the months of May and June, in which this period was obtained, can scarcely be considered midsummer. Finally, if it could have been foreseen that our hot spell of this year was to occur in August, and observations conducted accordingly, starting an experiment about three or four weeks later than was done, I think it will be conceded that this period would not have occupied more than the estimated five weeks.

PROTRACTED DEVELOPMENT.

From my experience with this and other species I have become convinced that cases of protracted development are not only not rare to a limited number of individuals of a brood, but seem to be normal, and hence may be "part and parcel" of the "wise provisions of nature" for the continuance of a species.

A larva of *Ephestia kuehniella* that had been placed in a small vial began spinning web May 9, but progressed very slowly, remaining motionless, always head downward, when examined daily for a week. Once or twice afterwards the larva was observed to have reversed its position, resting for several days at a time head upward. June 5 it was seen to have added a second coating of silk about double that first deposited. July 6 it had resumed its old position of resting head downward. It was always motionless, but wriggled when touched. The work of observing this larva had become tiresome, as it had not undergone any change for at least two months. October 1 the moth was found to have issued. It was living and slightly worn, showing that it had bred out during the last of September. The weather having been unseasonably hot during what must have been the pupal period, the duration of this stage may be placed as nine days, from which the quiescent larval period of this individual may be deducted as over five months. Before transforming this larva had deserted the old web and spun a new cocoon. The moth was of full size and not shriveled.

Experiment in flour.—The eggs laid April 18 served for the determination of the egg period and for the late spring life cycle period in corn meal as just related. The newly hatched larvæ were divided into two portions, the second lot placed in wheat flour gave rather surprising results, for whereas the meal-fed larvæ developed, as previously stated, in fifty-two days, not a moth issued from the flour until August 10, one hundred and fourteen days from the time of egg deposition. The flour was very fine and must have been exceedingly dry. The corn meal was fresh, yellow, of the best quality, and hygroscopic, which will explain the great difference in the periods of the larvæ feeding upon each.

An apparently normal case.—From the same lot of eggs that had begun to be deposited by a single female April 18 and placed in corn meal, full-grown caterpillars to the number of 9 were observed at rest at the top of the jar June 2. At the same time a cocoon was observed in the meal, which gave out the first moth June 9. Many more moths continued to issue from the meal, but were still maturing when the first moths from the larvæ that had spun up at the top of the jar issued. These latter appeared July 9, or just one calendar month later than the first lot, which is the period of the protracted development in this second instance for four individuals.

THE GRASSHOPPER DISEASE IN COLORADO.

By C. P. GILLETTE, *Fort Collins, Colo.*

In Bulletin 4 (p. 28) of the Minnesota Agricultural Experiment Station Dr. Lugger figures *Melanoplus bivittatus* as clinging after death to the top of some plant where it died of a fungous disease. So far as I am aware, there are no records of grasshoppers dying in a similar manner of a bacterial disease previous to the announcements in the papers of the country of such a disease carrying off large numbers of grasshoppers in Colorado last summer. Although I can say very little in regard to the specific organism that causes the disease under consideration, it will doubtless be of some interest to the members of the association to learn of the work of the disease in Colorado so far as I have been able to determine it.

On June 20, 1895, I received from Mr. George R. Lee, editor of the Brighton Register, a letter and a package, the latter containing a few grasshoppers that had died clinging with all their legs to the tops of alfalfa stems. The letter stated that grasshoppers were dying in this peculiar manner in great numbers about Brighton, and that the farmers were greatly interested in the matter and wanted to know the cause. In reply it was stated that the grasshoppers were apparently dying of a bacterial disease, and not from the parasitic attacks of other insects. This letter was published in the Brighton Register and was taken up by the Associated Press and published all over the country. I recommended that all who had grasshoppers that were not dying of the disease should obtain dead and dying hoppers from Brighton and endeavor to inoculate those in their own localities. Farmers drove long distances, and those who were too far away to drive wrote letters sending money for diseased grasshoppers. In this way the diseased hoppers were taken into many parts of the State, as well as into several surrounding States. I sent diseased hoppers to Dr. Lugger, of Minnesota, and Dr. Forbes, of Illinois, but I believe neither of these gentlemen succeeded in starting the disease in his locality.

It should be said to the credit of Judge N. H. Taylor, who lives upon his ranch near Brighton, that he first discovered the disease, and that he took a lively interest in scattering it as widely as possible. It was from his place that the larger part of the dead hoppers were sent out to infect those of other localities.

August 14 I visited the ranch of Mr. H. T. Miller, living 4 miles southwest of Fort Collins, where the grasshoppers were dying of the disease. Mr. Miller said he procured about 100 hoppers from Brighton, July 26, a few of which were still alive when received. He caught about 100 grasshoppers from his field and confined them with the diseased ones twenty-four hours and then allowed them to escape and put in another 100. This was repeated each day for seven days. On the

eighth day a few hoppers were found dead clinging to the tops of grain and alfalfa, and on the eleventh day they were dying rapidly over an area nearly a half mile in extent in the direction of the running water in the irrigating ditches. At the time of my visit the hoppers seemed to be dying rather slowly. I estimated, after considerable counting, that there was an average of 4 or 5 dead hoppers and three or four times that number of living ones to a square yard in Mr. Miller's fields where the disease was most prevalent. An interesting feature of the disease in Mr. Miller's fields was that for a considerable distance from the point of infection nearly all the hoppers were dying on the ground, only an occasional one being found clinging to the top of a plant, while from a quarter to a half mile from this point nearly all were dying on the tops of plants. It was noticed, also, that most of the dead hoppers were along irrigating ditches or upon low, moist ground. They were also abundant about hay ricks, where they accumulated in great numbers when the alfalfa was being gathered. They could be seen clinging to protruding straws to the very tops of the ricks. The progress of the disease was watched quite carefully upon Mr. Miller's place through the remainder of the grasshopper season. The hoppers died slowly to the last, but continued abundant, though they must have been greatly reduced by the disease. Mr. Miller affirms that they were not half as abundant a few days after the disease began taking them as they were before it appeared. Longmont, Colo., was twice visited, where the writer was shown every courtesy, and was driven to many farms, where the disease was spreading, by Mr. J. B. Adams, a successful farmer and bee keeper, who had introduced the disease on his place. Mr. Adams had followed my advice in introducing the disease, which was to crush the dead and diseased hoppers in a liberal quantity of water and to sprinkle this upon the living hoppers and their food plants about the borders of his fields in the evening when they were accumulating upon the tops of the plants for the night. When I visited Mr. Adams's place August 30 the hoppers seemed to be dying rapidly about those fields where the infection was introduced. A great many were seen in a dying condition. Near the border of one field a square yard was marked off at random and 52 dead or dying hoppers counted upon it. In these fields no hoppers could be found dying or dead upon the tops of the plants. A mile distant dead hoppers clinging to the tops of plants were found common, but not nearly as abundant as in Mr. Adams's fields. About 5 or 6 miles distant from Mr. Adams's place we came into a locality where dead hoppers were abundant, especially along ditch banks, clinging to the tops of plants.

In this locality we could not find that the disease had been introduced artificially by anyone.

Brighton was also twice visited, where everyone seemed more than willing to offer such assistance as he could in the investigation of the work of the disease. Mr. George R. Lee accompanied me to Judge

Taylor's ranch, and I was shown where the first dead hoppers were seen. It was upon low, wet ground bordering an alfalfa field. Judge Taylor said he had never seen the grasshoppers so numerous as they were in his fields when the disease appeared. At the time of my visit there were almost no hoppers to be seen on his place. The Judge said that his first cutting of alfalfa was literally black with hoppers of every size, from the very smallest to the fully grown. In a ride of 10 or 12 miles into the country about Brighton alfalfa fields were passed where the tops, as seen from the road, were distinctly blackened by the dead hoppers which were very often piled in clusters of two, three, or four together. In this locality the great majority of dead hoppers were clinging to the tops of plants. I found by inquiring that farmers who had not introduced the disease were about as likely to have it abundantly as any, but that does not seem strange, as so many did obtain it. Most farmers seemed to have noticed that it first appeared along ditches or on low ground.

Wheat Ridge, near Denver, was also visited, and Mr. David Brothers, a member of the State board of horticulture, showed me the work of the disease in his locality, where the hoppers were dying on the tops of plants in considerable numbers. He did not know that the disease had been artificially introduced in his neighborhood.

Observations and experiments with the disease at the college.—On account of miscarriage in the mails I did not obtain diseased hoppers in quantity for experiment early in the season. The first diseased hoppers were obtained August 14 from Mr. H. T. Miller and quantities were afterwards obtained from Brighton, Longmont, and Wheat Ridge. On August 14 a quantity of diseased hoppers were crushed in water and sprinkled upon living hoppers and their food in the fields in the evening. On the 16th, two days later, a single dead hopper was found clinging to an alfalfa stem, and from that time on the hoppers died slowly, mostly on the ground. During August and September the weather was dry and I can not learn that the disease spread rapidly anywhere.

Investigations in the laboratory.—(I can not at this writing find the book in which all the notes upon laboratory investigations were taken and will have to speak of this work quite briefly and from memory.) In the breeding cages the hoppers died much more rapidly than in the field, but in every instance they died on the ground and not clinging to the plants. Grasshoppers dying of the disease live but a few hours after they show from their actions that they are diseased, and when freshly dead they are perfectly healthy in appearance. They soon turn dark in color, however, and all the soft parts of the body become a dark, semifluid mass. The membranes between the segments of the body are so completely disintegrated that the head, thorax, and abdomen usually separate. The abdomen will often be found, soon after death, hanging in a flaccid condition and will come in pieces with the

slightest touch or may fall off of its own weight. After drying there are no soft parts left, but only a hollow skeleton throughout. The body fluids before death are, sometimes at least, literally crowded with germs. In one case, for example, the hind femur of a sick hopper that was still able to move about was cut across and the moist muscle wiped on a cover-glass, which showed the bacilli as abundant as the red corpuscles in a person's blood. Numerous cultures in agar were made from this and other hoppers in different stages of the disease, but in all cases cultures were obtained exactly resembling those of *Bacterium termo*, and we could isolate no other organism that would kill the hoppers when fed back to them. This close resemblance of these germs to *termo* led me to carry on a series of parallel experiments with these cultures and pure cultures of *termo* from beef broth. It was found that either germ sprayed on alfalfa and fed to healthy hoppers would kill inside of forty-eight hours, and if directly inoculated by needle thrusts into the bodies of the grasshoppers either would kill inside of twenty-four hours, while none would die in check cages where the insects received similar thrusts with sterilized needles. These results with *termo* alone were of much interest to me, as they suggest a possible new use of this, the most beneficial of all the Schizomycetes.

Insects reared from the dead grasshoppers.—It was common to find small maggots in the putrid bodies of hoppers that had been some time dead, but no such thing was found in the bodies of the sick hoppers that were still alive. I give below a list of the Diptera and Hymenoptera bred from the dead hoppers. The Diptera were determined by Mr. Coquillett, and the Hymenoptera by Mr. Ashmead. Mr. Coquillett also wrote, in reply to a question from me, that he did not think the Diptera could have been parasitic, but that they probably fed upon the dead bodies of the grasshoppers.

The Diptera were—

Sarcophaga cimbicis Town.,
Sarcophaga sarraceniæ Riley,
Sarcophaga, sp.
Cyrtoneura stabulans Fall.,
Helicobia helicis Town.

The Hymenoptera were—

Aphæreta muscæ Ash.,
Perilampus sp.

CONCLUDING REMARKS.

From my work and observations with the grasshopper disease I feel warranted in drawing the following conclusions:

1. That the grasshoppers have died in large numbers of some bacterial disease in Colorado during the summers of 1895 and 1896.

2. That the disease is most prevalent in a wet time and upon low ground.

3. That the disease may be spread artificially when the weather conditions are favorable, but that it is impossible to spread the disease with any degree of success in a dry time, and especially upon high ground.

4. That the disease confines its attacks almost exclusively to two species, *Melanoplus bivittatus* and *M. femur-rubrum*, so far as I have been able to observe, and that it attacks these equally in all stages of development.

5. As I have seen occasional dead grasshoppers clinging to the tops of plants in nearly every part of the State that I have visited, some of these places at long distances from points of artificial introduction of the disease, I believe it is probable that the disease is present in small amount in most localities and that an artificial introduction will usually do little or no good, though I should strongly advise the artificial introduction of the disease in fields not having it, whenever possible.

6. That the unusual appearance of the disease last year was due chiefly to the very extraordinary rainfall and the large number of rainy days during June and July.

A SIMPLE DEVICE FOR THE PREPARATION OF OIL EMULSIONS.

By H. A. Morgan, *Baton Rouge, La.*

The fact that the ingredients which enter into a kerosene emulsion are usually on hand, or may be easily procured at very little cost, together with the general efficiency of a well-prepared emulsion as an insecticide, recommends it at once to everyone, but the difficulty of getting a thorough emulsion and the danger of using one improperly prepared have had a tendency to offset the good qualities of which we have just spoken and to cause oil emulsions to become unpopular. This I have found to be the case with people who have only a few trees or plants affected with insects and who are not prepared with force pumps to be used to churn the emulsion.

It is to accommodate those who have found it difficult to churn the ingredients to a milk-like condition, and, too, to save the valves of the force pumps, which I have found become materially impaired by forcing the hot material through them, that I recommend the use of a simple churn, which may be described as follows:

The main portion consists of a tin cylinder 20 to 24 inches long and 4 inches in diameter; however, the diameter may be such that the churn will conveniently fit into the opening of a knapsack sprayer, for it may be often convenient to churn the ingredients within the sprayer. Within an inch of the bottom of the cylinder is a row of seven small openings (of course the number may vary, but in a 4-inch cylinder seven, each with a diameter not more than three-eighths of an inch, will be found sufficient). In the bottom of the cylinder there is in the figure

a large opening three-fourths of an inch in diameter, which I had put there for drainage after removing the churn, but I believe the churn operates better without the opening.

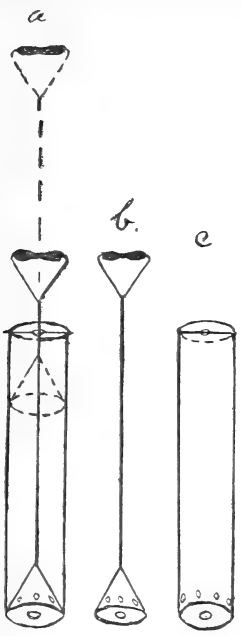

FIG. 5.—Device for preparing oil emulsions.

The plunger consists of a tin cone attached to a three-eighths-inch iron rod, at the other end of which is attached a handle, which may project any distance above the top of the cylinder. The cone has a base of such diameter as will nicely fit into the cylinder, and may be from 3 to 3½ inches high. About three-fourths of an inch above the base is a row of five openings of the same size as those in the base of the cylinders; here, too, the number of openings may vary, but I have found five ample. In the center of the base of the cone is a large opening three-fourths of an inch in diameter.

The churn may be used with or without a lid. I find it saves time, but wastes a little material at times, to do without the cover.

The entire cost of making this churn should not be more than 40 or 50 cents.

The figure which accompanies this paper may assist in understanding the general make-up of the pump.

Mr. Bethune presented the following resolution relative to the late Dr. C. V. Riley, which was unanimously adopted:

This association at its first meeting since the death of Dr. C. V. Riley, last September, who was its originator and first president, desires to place upon record its deep regret at the loss which it has sustained by his untimely removal. He was acknowledged to be the highest authority in this or any other country on economic entomology, and to have held a rarely equaled reputation for scientific work. While entomological science has been deprived of one of its ablest exponents, the members of this association feel also that they have personally to lament the loss of a true and warm-hearted friend.

The committee appointed to nominate officers for the ensuing year, consisting of Messrs. Smith, Lintner, and Forbush, made the following nominations:

President, F. M. Webster, Wooster, Ohio.
First vice-president, Herbert Osborn, Ames, Iowa.
Second vice-president, Lawrence Bruner, Lincoln, Nebr.
Secretary, C. L. Marlatt, Washington, D. C.

A ballot resulted in the unanimous election of the persons nominated.

On motion of Mr. Lintner, the time and place of meeting was fixed as heretofore, viz, on the two days preceding the general sessions of the American Association for the Advancement of Science, and at the place selected for the meeting of that association.*

On motion of Mr. Howard, the reading and adoption of the rough minutes of the entire session were dispensed with.

On motion of Mr. Hopkins, the United States Department of Agriculture was requested to publish the proceedings of the session just closing, as heretofore.

Mr. Lintner presented the following resolution, which was unanimously adopted:

Whereas it has come to the knowledge of the members of this association that a general index to the seven volumes of Insect Life has been prepared and is in readiness for publication, and that question of its publication has arisen in consideration of the expense that would attend it: Therefore,

Be it resolved, That this association most earnestly requests the speedy publication of the index as an almost indispensable supplement to a series of volumes of incalculable value to every economic entomologist.

On motion of Mr. Howard, a vote of thanks was given to the local committee for their efforts in making arrangements for the present session of the association.

On motion of Mr. Howard, a vote of thanks was given to Mr. E. P. Van Duzee for his efforts in making preliminary arrangements for hotel accommodations for the entomologists.

On motion of Mr. Hopkins, a vote of thanks was given to the president and secretary for the eminently satisfactory manner in which they had conducted the business of the session.

The association then adjourned, subject to the call of the executive committee.

C. L. MARLATT, *Secretary.*

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* Detroit, Mich., August 6, 1897.

CONSTITUTION AND BY-LAWS OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

[Adopted at a meeting held at Toronto, Canada, August 29–30, 1889, and subsequently amended.]

CONSTITUTION.

SECTION I. This association shall be known as the Association of Official Economic Entomologists.

SECTION II. Its objects shall be: (1) To discuss new discoveries, to exchange experiences, and to carefully consider the best methods of work; (2) to give opportunity to individual workers of announcing proposed investigations, so as to bring out suggestions and prevent unnecessary duplication of work; (3) to suggest when possible certain lines of investigation upon subjects of general interest; (4) to promote the study and advance the science of entomology.

SECTION III. The membership shall be confined to workers in economic entomology. All economic entomologists employed by the General or State governments or by the State experimental stations or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutions may become members of the association by transmitting proper credentials to the secretary and by authorizing him to sign their names to this constitution. Other persons engaged in practical work in economic entomology may be elected by a two-thirds vote of the members present at a regular meeting and shall be termed associate members. Members residing outside of the United States or Canada shall be designated foreign members. Associate and foreign members shall not be entitled to hold office or to vote.

SECTION IV. The officers shall consist of a president, two vice-presidents, and a secretary, to be elected annually, who shall perform the duties customarily incumbent upon their respective offices. The president shall not hold office for two consecutive terms.

SECTION V. The annual meeting shall be held at such place and time as may be decided upon by the association at the previous annual meeting. Special meetings may be called by a majority of the officers, or shall be called on the written request of not less than five members. Eight members shall constitute a quorum for the transaction of business.

SECTION VI. The mode of publication of the proceedings of the association shall be decided upon by open vote at each annual meeting.

SECTION VII. All proposed alterations or amendments to this constitution shall be referred to a select committee of three at any regular meeting, and after a report from such committee may be adopted by a two-thirds vote of the members present; *Provided*, That a written notice of the proposed amendment has been sent to every voting member of the association at least one month prior to date of action.

BY-LAWS.

[Adopted at a meeting held at Washington, D. C., November 12, 1889.]

ARTICLE I.—*Of members.*

SECTION 1. The classes of members are defined in the constitution, as are their rights to vote or hold office. Members of all kinds have equal privileges as to presentation of papers and in the scientific discussions at the regular meetings, and may, by permission of the presiding officer, speak on business questions before the association.

SECTION 2. All members have equal rights to the published proceedings of the association and to any publications controlled by or distributed by the association, save that should any publications of economic interest be distributed by the association the distribution lists furnished by the active members are first to be regarded.

ARTICLE II.—*Of officers and their duties.*

SECTION 1. It shall be the duty of the president, in addition to the ordinary duties of a presiding officer, to prepare and deliver an annual address, to be delivered at the annual meeting over which he presides.

SECTION 2. It shall be the duty of the secretary to provide the necessary stationery and such books as he may be directed to provide, the expenses of which shall be met by an assessment of not less than 25 cents on the members in attendance at the meetings. The sum so collected shall be used by the secretary to reimburse himself for advances made and to meet the ordinary expenses of the association. An account shall be rendered at each annual meeting, and if needed an additional assessment shall be imposed.

SECTION 3. All officers shall be elected by ballot after open nomination, and this by-law shall not be suspended except by unanimous consent of the voting members present.

ARTICLE III.—*Of meetings.*

SECTION 1. Notice of the time and place of meetings shall be published in all the American entomological periodicals and in Insect Life.

SECTION 2. Special meetings shall be called as provided for in the constitution, and notice of such meetings shall be given by the secretary by mailing to each voting member a formal specification of the time and place of meeting at least two weeks before the date fixed in the notice. The notice shall state the reason for such meeting and shall specify the business to be transacted, and no other business shall be transacted.

SECTION 3. The order of business at regular meetings shall be, at the first session:

(1) Calling the meeting to order by the president.
(2) The annual address of the president.
(3) Reports of officers.
(4) Reports of committees.
(5) Proposal and election of members.
(6) Written business communications.
(7) Verbal business communications.
(8) New business.
(9) Programme of papers and discussions.
(10) Adjournment.

On the following sessions:

(1) Reading and action on the minutes of previous meetings.
(2) Unfinished business.
(3) Proposal and election of members.
(4) New business.
(5) Programme of papers and discussions.
(6) Adjournment.

At the last session of the meeting the order of business shall be as at other sessions, except that after order 5 will come:

(6) Election of officers for the next meeting.
(7) Fixing time and place of next meeting.
(8) Reading and action on rough minutes of the entire session.
(9) Final adjournment.

ARTICLE IV.—*Amendments to by-laws.*

SECTION 1. Changes in these by-laws may be made at any regular meeting in the same manner and on the same notice as prescribed in the constitution for the amendments to that instrument.

AMENDMENTS.

SECTION V. The annual meeting shall be held at such place and time as may be decided upon by the association at the previous annual meeting, and special meetings may be called by a majority of the officers. Eight members shall constitute a quorum for the transaction of business. (Proposed November 14, 1889; adopted November 12, 1890.)

SECTION I. This association shall be known as the Association of Economic Entomologists. (Proposed November 14, 1889; adopted November 13, 1890.)

SECTION III. The membership shall be confined to workers in economic entomology. All economic entomologists employed by the General or State governments, or by the State experiment stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutes may become members of the association by transmitting the proper credentials to the secretary, and by authorizing him to sign their names to this constitution. Other persons engaged in practical work in economic entomology may be elected by a two-thirds vote of the members present at any regular meeting of the association. Members residing out of the United States or Canada shall be designated foreign members. Foreign members shall not be entitled to hold office or to vote. (Proposed November 13, 1890, and worked under until 1895, when it was formally adopted August 27.)

LIST OF THE MEMBERS OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

ACTIVE MEMBERS.

Adams, M. F., Buffalo, N. Y.
Aldrich, J. M., Moscow, Idaho.
Alwood, William B., Blacksburg, Va.
Ashmead, William H., Washington, D. C.
Baker, C. F., Auburn, Ala.
Banks, Nathan, Seacliff, N. Y.
Beckwith, M. H., Elmira, N. Y.
Bethune, C. J. S., Port Hope, Ontario.
Bogue, E. E., Stillwater, Okla.
Bruner, Lawrence, Lincoln, Nebr.
Bullard, W. S., Bridgeport, Conn.
Campbell, J. P., Athens, Ga.
Chambliss, C. E., Knoxville, Tenn.
Chittenden, F. H., Washington, D. C.
Cockerell, T. D. A., Mesilla, N. Mex.
Collins, Lewis, Brooklyn, N. Y.
Comstock, J. H., Ithaca, N. Y.
Cook, A. J., Claremont, Cal.
Cooley, R. A., Amherst, Mass.
Coquillett, D. W., Washington, D. C.
Cordley, A. B., Corvallis, Oreg.
Davis, G. C., Agricultural College, Mich.
Doran, E. W., Edmond, Okla.
Fernald, C. H., Amherst, Mass.
Fletcher, James, Ottawa, Canada.
Forbes, S. A., Urbana, Ill.
Forbush, E. H., Malden, Mass.
Frost, H. L., Boston, Mass.
Garman, H., Lexington, Ky.
Gifford, John, Mays Landing, N. J.
Gillette, C. P., Fort Collins, Colo.
Goding, F. W., Rutland, Ill.
Gossard, H. A., Ames, Iowa.
Hargitt, C. W., Syracuse, N. Y.
Harrington, W. H., Ottawa, Canada.
Hart, C. A., Urbana, Ill.
Harvey, F. L., Orono, Me.
Hillman, F. H., Reno, Nev.
Hine, J. S., Columbus, Ohio.
Hopkins, A. D., Morgantown, W. Va.
Howard, L. O., Washington, D. C.
Hubbard, H. G., Washington, D. C.
Hudson, G. H., Plattsburg, N. Y.
Hulst, G. D., Brooklyn, N. Y.
Johnson, W. G., College Park, Md.
Kellicott, D. S., Columbus, Ohio.
Kirkland, A. H., Malden, Mass.
Lintner, J. A., Albany, N. Y.
Lowe, V. H., Geneva, N. Y.
Lugger, Otto, St. Anthony Park, Minn.
Mally, C. W., Wooster, Ohio.
Mann, B. P., Washington, D. C.
Marlatt, C. L., Washington, D. C.
Morgan, H. A., Baton Rouge, La.
Murtfeldt, Miss M. E., Kirkwood, Mo.
Niswander, F. J., Cheyenne, Wyo.
Osborn, Herbert, Ames, Iowa.
Packard, A. S., Providence, R. I.
Palmer, R. M., Victoria, British Columbia.
Pergande, Th., Washington, D. C.
Perkins, G. H., Burlington, Vt.
Popenoe, E. A., Manhattan, Kans.
Rane, F. W., Durham, N. H.
Reed, E. B., Esquimault, Brit. Columbia.
Rolfs, P. H., Lake City, Fla.
Rumsey, W. E., Morgantown, W. Va.
Saunders, William, Ottawa, Canada.
Schwarz, E. A., Washington, D. C.
Sirrine, F. A., Jamaica, N. Y.
Slingerland, M. V., Ithaca, N. Y.
Smith, J. B., New Brunswick, N. J.
Snow, F. H., Lawrence, Kans.
Southwick, E. B., New York, N. Y.
Stedman, J. M., Columbia, Mo.
Stimson, James, Watsonville, Cal.
Summers, H. E., Champaign, Ill.
Test, F. C., Dundee, Ill.
Thaxter, Roland, Cambridge, Mass.
Toumey, J. W., Tucson, Ariz.
Townsend, C. H. T., Las Cruces, N. Mex.
Washburn, F. L., Eugene, Oreg.
Webster, F. M., Wooster, Ohio.
Weed, C. M., Durham, N. H.
Weed, H. E., Agricultural College, Miss.
Wilcox, E. V., Bozeman, Mont.
Woodworth, C. W., Berkeley, Cal.

FOREIGN MEMBERS.

Berlese, Dr. Antonio, R. Scuola Superiore di Agricoltura, Portici, Italy.
Bos, Dr. Ritzema, Wageningen, Holland.
Carpenter, Prof. George H., Nat. Hist. Mus., Dublin, Ireland.
Cholodkowsky, Prof. Dr. N., Institut Forestier, St. Petersburg, Russia.
Cotes, E. C., 201 Iffley road, Oxford, England.
Danysz, J., Laboratoire de Parasitologie, Bourse de Commerce, Paris, France.
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Grasby, W. C., Parkside, Adelaide, South Australia.
Horvath, Prof. Geza, Ministry of Agriculture, Budapest, Austria.
Lampa, Prof. Sven, Department of Agriculture, Stockholm, Sweden.
Lindeman, Dr. K., Landwirthschaftliche Akademie, Moscow, Russia.
Lounsbury, Charles P., Department Agriculture, Cape Town, South Africa.
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Portschinsky, Prof. A., Ministère de l'Agriculture, St. Petersburg, Russia.
Reed, E. C., Rancagua, Chile.
Reuter, Dr. Enzio, Fredriksgatan 45, Helsingfors, Finland, Russia.
Schoyen, Prof. W. M., Christiania, Norway.
Shipley, Prof. Arthur E., Cambridge, England.
Targioni-Tozzetti, Prof. A., R. Staz. d. Entom. Agrar., Florence, Italy.
Theobald, Frederick B., Wyecourt, Kent County, England.
Thompson, Rev. Edward H., Hobarttown, Tasmania.
Tryon, H., Brisbane, Queensland, Australia.
Urich, F. W., Arima, Trinidad, West Indies.
Whitehead, Charles, Barming House, Maidstone, Kent, England.
Wight, R. Allan, Paeroa, Auckland, New Zealand.